ERDC/CERL TR-07-49

US Army Corps
of Engineers®
Engineer Research and
Development Center

Joint Distributed Regional Training Capacity

A Scoping Study

James Westervelt, Michael P. Case, Michael L. Hargrave, Susan J. Bevelheimer, Linda J. McCarthy, Karl D. Radnitzer, Kay McGuire, William D. Meyer, Joseph S. Rank, Bruce A. MacAllister, Byung J. Kim, Neils G. Svendsen, and Heidi Howard

December 2007

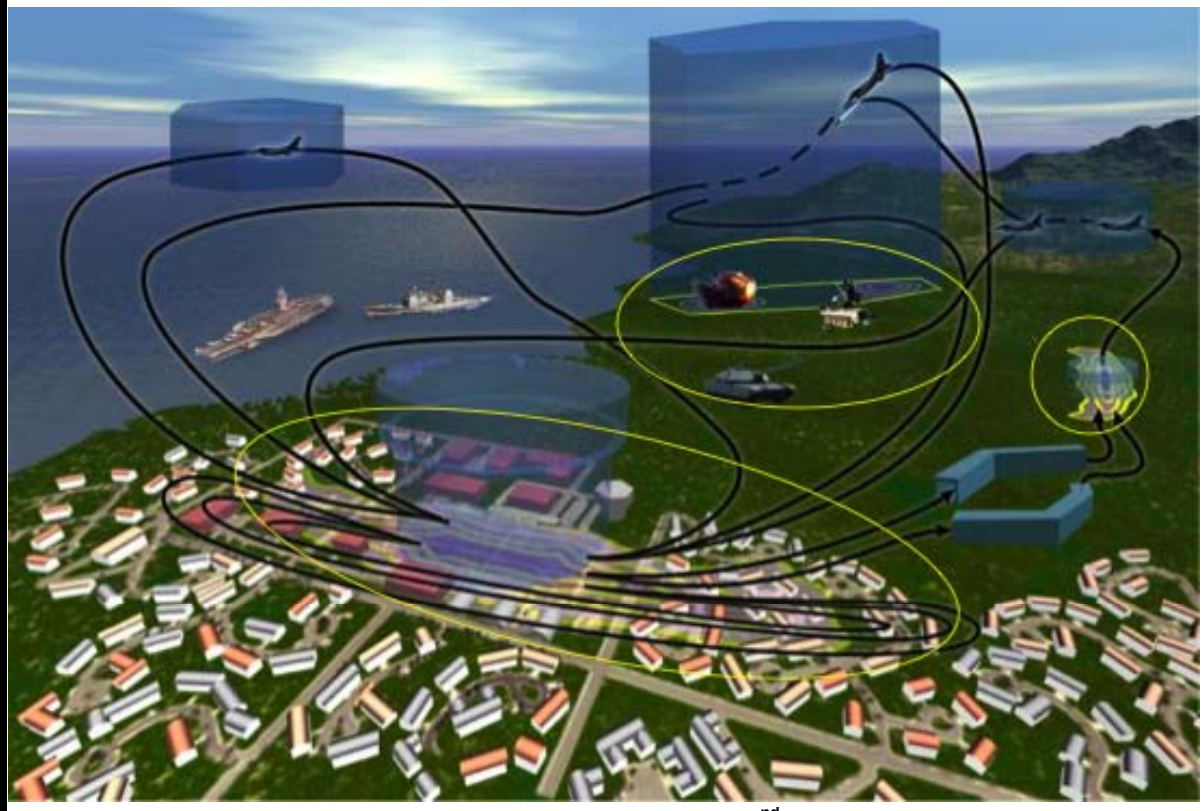

Illustration of "Competition for Natural Infrastructure" (from the 2nd DOD Sustainable Ranges Initiative Conference & Exhibition, San Antonio, TX, August 2005).

Construction Engineering
Research Laboratory

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Final Report

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Abstract: Current Army National land use strategy seeks to protect current training/testing areas, and address shortcomings with computer simulation, a strategy insufficient to completely meet future training and testing needs. The transformation of the U.S. Army and Department of Defense (DoD) will incorporate new weapons and tactics requiring more training land and more frequent joint-Service training than current fenced installations containing tracts of contiguous land can accommodate.

This document investigates the need for a joint, distributed, and regional land use strategy that will facilitate the Army and DoD's ability to develop training/testing areas and large multi-service exercises within increasingly populated areas and regions. It examines capabilities that will be required to adopt this strategy and specifies the scope of research and development efforts, analyses, and studies required to fill capability gaps. The study team determined that Army requirements were not sufficiently documented at the time of the study to recommend creation of a dedicated Joint Distributed Regional Training work package using Army applied research (6.2) funds. This team recommends that ERDC use these results as a basis to work with the Army Environmental Requirements and Technology Assessments (AERTA) process to develop validated requirements upon which to base more focused work packages.

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Preface

The work was performed by the Engineering Processes Branch (CF-N) of the Facilities Division (CF), Construction Engineering Research Laboratory (CERL). The CERL Principal Investigator was Dr. James Westervelt. Donald K. Hicks is Chief, CEERD-CF-N, and L. Michael Golish is Chief, CEERD-CF. The Director of ERDC-CERL is Dr. Ilker R. Adiguzel.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Commander and Executive Director of ERDC is COL Richard B. Jenkins, and the Director of ERDC is Dr. James R. Houston.

Unit Conversion Factors

Multiply	By	To Obtain
acres	4,046.873	square meters
cubic feet	0.02831685	cubic meters
cubic inches	1.6387064 E-05	cubic meters
cubic yards	0.7645549	cubic meters
degrees (angle)	0.01745329	radians
degrees Fahrenheit	(F-32)/1.8	degrees Celsius
feet	0.3048	meters
gallons (U.S. liquid)	3.785412 E-03	cubic meters
inches	0.0254	meters
miles (U.S. statute)	1,609.347	meters
miles per hour	0.44704	meters per second
pounds (mass)	0.45359237	kilograms
square feet	0.09290304	square meters
square inches	6.4516 E-04	square meters
square miles	2.589998 E+06	square meters
square yards	0.8361274	square meters
tons (2,000 pounds, mass)	907.1847	kilograms
yards	0.9144	meters

1 Introduction

1.1 Background

The U.S. Army and Department of Defense (DoD) are facing new training challenges on many fronts. Two in particular are daunting. First, evolving weapons and tactics continue to demand ever-increasing amounts of land to conduct realistic live training. This demand often exceeds the capacity of a single installation. Second, there is an increasing need for joint training. To "train as we fight," exercises will need to make greater use of joint combined arms and training assets available across all DoD.

One emerging solution is to use regional training assets composed of multiple installations and non-DoD lands. The U.S. Marine Corps conducted one such exercise, called "Desert Scimitar," in which forces maneuvered from the 29 Palms Marine Corps base across land maintained by the Bureau of Land Management, ending at Yuma Proving Grounds. Another recent example can be found in the agreement between the Army and the Department of Energy (DOE) to use the DOE Savannah River site for military training. With the DOE Savannah River site, the installations in the region form a pool of regional resources that can be configured to conduct training exercises larger than any one installation can hold.

Planning and executing a training exercise that involves multiple installations and non-DoD lands is a massive undertaking. Planners must determine how to best achieve the necessary training effect, involving the use of DoD assets, public roads, lands, and airspace. They must also negotiate with multiple agencies and public bodies to allow the use of those assets. This negotiation includes the need to consider environmental impacts under the National Environmental Policy Act (NEPA). The environmental impact analysis for Desert Scimitar included impacts of noise, water crossings, traffic, airspace, and threatened and endangered species. It was a massive, expensive document that was only valid for one exercise.

The practice of conducting a large environmental assessment study each time an exercise is planned is needlessly expensive and does not give the flexibility to configure training assets as needed for future missions. It also does not look ahead to determine if those training assets will continue to be available in the future or if new assets may become available.

This document examines the feasibility and scope of conducting research to create an analysis capability that will make it possible to understand the capability and capacity of configurations of regional training lands to support live training. This capability will require new forms of spatial analysis, as well as temporal analysis that takes into account projected changes of spatial attributes and relationships over time. The expected payoff would be an ability to rapidly configure the best use of training assets, discover new assets, and negotiate on a best-science foundation.

1.2 Objectives

The objective of this work was to develop and propose a joint, distributed, and regional land use research strategy that will facilitate the Army and DoD's ability to conduct regional training/testing in the form of large multi-service exercises within increasingly populated areas and regions.

1.3 Approach

The analysis is first described in detail and then specific potential topics were developed for R&D efforts, analyses, and studies required to facilitate the developed strategy.

1.4 Mode of Technology Transfer

This report will be made accessible through the World Wide Web (WWW) through URL: http://www.cecer.army.mil

2 Emerging Land Use Requirements

2.1 The Army's Current National Land Use Strategy

RAND Corp. prepared a report for the United States Army entitled "Does the Army Have a National Land Use Strategy?" (Rubenson et al. 1999), which concluded that the Army has a "coherent, but implicit" strategy that is difficult to explain due to organizational boundaries, that physical distances between installations effectively isolate them, and that physical boundaries make aggregate needs and land meaningless.

For much of the history of the United States, the Army's land use strategy was to acquire land from relatively abundant available sources. Historically, the location of some military installations met needs for establishing defense positions, while others were placed on affordable sites that were commercially and politically acceptable at local, state, and government levels. The government could and did condemn land with little or no opposition.

Over time, however, the ability to establish new installations, or to expand current installations, has become increasingly problematic. Numerous laws tightly control the process of establishing new areas, and various political and stakeholder interest groups ensure that the public will be engaged at every step of the way. Figure 1 shows some of the pressures that can limit the Army's ability to test and train on installation lands. Navigating the process is costly – both in time and money.

2.2 Protecting Current Installations and Ranges

The focus has shifted from expansion of military training and testing areas to primarily a protection of the training and testing areas currently in the inventory. The circle surrounding the Soldiers in Figure 1 evokes an image of a "circling of the wagons" against attacks from all sides. This image has been used in presentations by DASA-IE and DASA-ESOH to convey the challenges to sustaining military training and testing missions at installations. Raymond J. Fatz, DASA-ESOH, used this image in a presentation at an Army Range Sustainability conference held 6 October 2003.

Figure 1. Increasing pressures on training and testing.

In this talk he presented six key sustainability messages:

1. The first time Soldiers experience realistic battlefield conditions must not be in combat.
2. Live-training is critical to a ready force.
3. The Army must maintain access and capabilities of ranges and training land — move, shoot, communicate.
4. Encroachment-induced restrictions are limiting realistic preparations for combat.
5. Targeted legislative, regulatory, and administrative strategies are needed to balance both military needs and environmental protection.
6. The Army's outstanding environmental stewardship will continue.

These messages clearly indicate the defensive posture the Army has adopted in the face of the circle of legislative, urban development, and stakeholder groups that are collectively eroding the ability of the Army to prepare the sons and daughters of the United States to succeed and survive in battle. To centrally deal with these encroachment issues, the Army

has established the Sustainable Range initiative, which identifies nine critical encroachment issue areas and associated action plans:

1. Endangered Species Act
2. Unexploded Ordnance and Other Constituents
3. Frequency Encroachment
4. Maritime Sustainability
5. National Airspace System
6. Air Quality
7. Airborne Noise
8. Urban Growth
9. Outreach.

DoD has created an Integrated Product Team, led by the Office of the Under Secretary of Defense for Personnel and Readiness, to act as the DoD coordinating body for developing the strategy to preserve the military's ability to train.

2.3 Compatible Land Use Studies

A major part of the current Army National land use strategy involves joint land use studies. Such studies can be conducted at the local, state, or regional levels and seek to identify a future land use design that will collectively meet the needs of all concerned parties. Then, judicious use of zoning, subdivision, and building regulations can help provide a path to that future. The following sections describe such studies, which tend to focus on preserving current missions, current training and testing areas, and current training and testing levels.

California

> The encroachment problem is more complicated than just urban growth edging closer and closer to installation boundaries. Many military installations conduct operations beyond their boundaries, generating significant aircraft and artillery noise.
>
> – John Landis, et al. *Forecasting and Mitigating Future Urban Encroachment Adjacent to California Military Installations: A Spatial Approach.*

In response to military installation encroachment concerns in California, the California Technology, Trade, and Commerce Agency sponsored a study by the University of California, Berkeley (Landis, Foster et al. 2001; Landis, Reilly et al. 2001). One half of the 64 military installations are as-

sociated with major metropolitan areas. With California's population expected to expand from 34 million people in 2000 to 45 million in 2020, "people living within earshot of military activities will also grow." In addition, continued suburban growth consumes habitat, which puts increasing pressure on installations to preserve what habitat remains. The study involved GIS analyses of 23 of the 26 major active military installations and found that "the biggest encroachment impacts will be limited to just a few bases ...," making the problem of encroachment "mostly an installation-specific one." The reports offer the following recommended approaches to solving encroachment problems:

- Revisions to state general plan law, requiring consideration of military base encroachment issues.
- Revisions to the California Environmental Quality Act (CEQA) to require that potential encroachment impacts be considered in the conduct of initial studies and that environmental impact reports be undertaken for land development projects located within a specific distance of a military base; such reports would require that positive steps be taken to deal with specific encroachment issues.
- State review of local plans. Broadly based on the California Coastal Commission model, this approach would require state-level review of local general plans for cities and counties encompassing or abutting military bases.
- State appeal of local permitting decisions. Development permitting under this framework would have four components, similar to the previous approach. The state would first designate geographic areas or zones around each military base where encroachment would potentially threaten base operations. Second, the state would issue permitting guidelines for use in local reviews of projects falling within the designated zones. These guidelines could list appropriate and inappropriate land uses, conditions of approval, and required mitigations. Third, local governments would be required to consider guideline provisions when issuing development permits. Last, the military would retain the right to appeal locally-approved projects to a state agency on the grounds that state guidelines were not adequately followed.
- State review of local permitting. Procedurally, this approach would be similar to the previous two except that the state would be required to review every locally-granted zoning and/or subdivision permit issued within a designated encroachment zone.
- Add-on state permitting. Under this approach, broadly based on the model of the San Francisco Bay Conservation and Development Commission, developments and subdivisions in designated encroachment

zones would require a permit first from local government, but then also, de novo, from a special state agency or commission charged with protecting potential encroachment areas from inappropriate development.

- Preemptory state permitting. Under this approach, for which there is no existing state model, planning and/or permitting authority within designated encroachment zones would be transferred from local government to an appropriate state agency or commission charged with protecting such areas from inappropriate development.
- Mandatory multi-jurisdictional planning and permitting responsibility. Under this approach, jurisdictions adjacent to military installations would be mandated to form encroachment zone joint powers authorities (EZJPAs) for the purpose of coordinated planning and land preservation/acquisition.
- Intergovernmental planning and permitting responsibility. Under this alternative, a single statewide commission would be established to undertake all planning and permitting responsibilities within all designated encroachment areas.
- Multi-jurisdictional land conservancies. Under this more limited version of the previous option, Federal, state, and local government agencies would combine to charter and fund encroachment zone land conservancies (EZLC) around military installations. EZLCs would have two responsibilities, to: (1) acquire private lands and/or the development rights to private lands within encroachment zones; and (2) actively manage those lands as needed.

Report to Congress on Sustainable Ranges

> Many of these laws and regulations were developed with little consideration of military training and testing, and the operation of ranges. As a result, application of the requirements under these laws can have unintended consequences that adversely affect the military's ability to conduct realistic training and testing.
>
> – DoD. (February 2006). *Report to Congress on Sustainable Ranges*.

The Army and DoD have sought congressional relief from many of the laws that are constricting the use of military training and testing areas (Figure 1). In response, Congress, through Section 366 of the FY 2003 National Defense Authorization Act (NDAA), required the Department of Defense (DoD) to annually report on the operational condition of training and test ranges; on current and future training range requirements; and on a plan for how DoD will meet those requirements. Then, in Section 320 of the FY

2004 NDAA, Congress required DoD to report on the impacts of urban encroachment on military installations and operational ranges and the impact of environmental compliance. Again, Congress requested a report of the Department's progress in developing a comprehensive plan to address constraints that limit its use of military lands, water, airspace, and communication spectrum.

The February 2006 report to Congress (Office of the Secretary of Defense 2006) describes the encroachment problem by illuminating the important work that the military is doing for the nation and how laws and regulations must not unduly hamper that work. It then describes various associated efforts within DoD and its services that are individually and collectively attacking the encroachment challenges. These include the Sustainable Ranges Initiative (SRI) and the Joint Land Use Studies (JLUS) program. The Army, along with the other services, has a comprehensive range planning and management process as a part of the SRI. The OSD Office of Economic Adjustment is working to expand and apply the JLUS program to help communities and installations plan development around installations in a manner that sustains the capabilities of training and testing ranges. In addition, the report discussed new initiatives to proactively develop programs to protect installations from nearby urbanization, work with governments and NGOs to promote compatible land use, educate stakeholders in the importance of training and testing needs, develop and modify laws to help protect training and testing ranges, and create land use partnerships through conservation buffers.

Office of Economic Adjustment Joint Land Use Study (OEA JLUS)

> Most of the 500 military active military bases in the United States and its territories were originally located in relatively remote areas, both for security purposes and to provide ample buffers between their operations and civilian populations. Over the years however, the economic opportunities that these installations offer have made them magnets for development, and today communities are crowding around military bases nationwide.
>
> – Office of Economic Adjustment JLUS video.

Many installations and their communities have conducted joint land use studies – many in a formal manner using Joint Land Use Study grants provided by the Office of Economic Adjustment (OEA), which is part of the Office of the Secretary of Defense (OSD). One of the things that distinguishes us from all other life on earth is the depth and variety of our capac-

ity to communicate. Communication leads to understanding, cooperation, collaboration, and planning. JLUS grants provide a kernel of funding upon which local, regional, state, and Federal stakeholders can build new understandings, relationships, and eventually regional plans designed to take everyone to a mutually desirable regional future. The JLUS program was initiated by the Department of Defense in 1985 to better apply AICUZ, ENMP/RAICUZ, and ICUZ programs. Formerly, these programs used one-sided studies designed to communicate, in a one-way fashion, the impacts of military activities on areas outside an installation's fenceline.

The JLUS approach responded to the need for parties to coordinate planning across installation borders. The Joint Land Use Study Program Guidance Manual (Office of Economic Adjustment 2002) provides guidance on how to successfully conduct a JLUS. This manual has recently been augmented with a 600-page guide (Office of Economic Adjustment and National Governor's Association Center for Best Practices 2005), which provides detailed information about how governments work, who needs to be involved in regional planning decisions, how decisions can be made, and successful case-study applications of the JLUS program. A JLUS proceeds by bringing together all of the stakeholders interested in long-range planning, collectively identifying characteristics of a desired future state, and finding plans and investments that will help the entire community realize that future.

2.4 Army and DoD Offices Concerned with Land

The Office of the Assistant Secretary of the Army for Installations and Environment (ASA-IE)

Name: The Office of the Assistant Secretary of the Army for Installations and Environment

The Deputy Assistant Secretary of the Army for Environment, Safety, and Occupational Health (DASA-ESOH)

Name: The Deputy Assistant Secretary of the Army for Environment, Safety, and Occupational Health

Reports to: ASA-IE

Deputy Assistant Secretary of the Army for Installations and Housing (DASA-I&H)

Name:	Deputy Assistant Secretary of the Army for Installations and Housing
Reports to:	ASA-IE
Vision:	Create sustainable installations that support missions of the transformed Army with land, buildings and infrastructure providing excellent quality of life support for Soldiers and their families.
Mission Statement:	Provide worldwide policy, programming and oversight of the Secretary of the Army's Title 10 US Code responsibilities in the areas of real estate, military construction, engineering, housing and base realignments and closures. Provides oversight reviews, approvals, congressional testimony and notifications as required by statutes in the responsible areas.
Goals/ Objectives:	Justify and secure the necessary resources to sustain Army installations and establish policies and oversight that ensures efficient and effective use of the resources in realizing the vision and accomplish the mission

Army Environmental Policy Institute (AEPI)

Name:	The Army Environmental Policy Institute
Reports to:	DASA-ESOH
Mission Statement:	Support the Army Secretariat and their top priority, the Army Soldier.
Goals/ Objectives:	Visualize potential issues that may affect the Army in the future. Analyze the effect off these issues on the Army and its Soldiers. Inform leadership. Communicate recommendations to those with the power and resources to implement leader direction.

Assistant Chief of Staff for Installation Management (ACSIM)

Name:	Assistant Chief of Staff for Installation Management
Reports to:	Army Headquarters
Vision:	Installation Vision 2010: To adequately support a future Army capable of conducting prompt and sustained operations on land throughout the entire spectrum of crisis, AND to support the joint warfighting team envisioned in Joint Vision 2010 and Army Vision 2010, Installation Vision 2010 must create enduring installations, armories and reserve centers that: • support the warfighter, • focus on Army core competencies,

- implement best business practices,
- eliminate excess and maximize use of facilities,
- provide quality living and working environments, and
- maintain stewardship of assets.

http://www.hqda.army.mil/acsim/ops/LETTER~1.PDF#search=%22ACSIM%20vision%22

The Integrated Training Area Management (ITAM) Program

The Sustainable Range GIS Support Program (SRP GIS) supports the Sustainable Range Program. The goal is to provide information excellence through geo-spatial data and applications that ensure mission support. SRP GIS strives to achieve this goal by providing the best, most accurate, complete data through user-friendly products and applications. This support includes the development of GIS databases that meet geo-spatial data requirements that establish central product and applications support to the SRP and other installation mission support offices, and that adhere to Federal, DoD and Army spatial data standards. The group also works to reduce costs and eliminate redundancies by participating in installation and Army Enterprise GIS initiatives. The SRP GIS Program is supported by the SRP GIS User Working Group (SRP GIS UWG) and the SRP Regional Support Centers (SRP RSCs), and annually hosts GIS Day at the Integrated Training Area Management (ITAM) Workshop. Additional information on SRP GIS can be found within the GIS content section of the SRPWeb.

The SRP GIS User Working Group. This working group is chaired by the U.S. Army Environmental Center (USAEC), co-chaired by the Army Training Support Center (ATSC), and is composed of installation and Major Command (MACOM) GIS users and technicians. The user working group recommends standards, performs core functional requirements, maintains GIS applications, oversees tasks and operations of the Regional Support Centers (RSCs), and organizes and runs annual workshops. This group meets twice per year, and contains sub-groups for the GIS Workshop, GIS Standards, and SRP GIS applications.

The Annual GIS Workshop. The annual GIS workshops have been conducted since 1999 in conjunction with the ITAM workshop. The workshop is organized by the SRP GIS User Working Group in coordination with the ITAM Installation Steering Committee. The goal of the workshop is to provide an opportunity for the entire SRP GIS community to gather in a forum to present and exchange GIS technology solutions and applications.

Major components of the workshop include keynote addresses, technical presentations, demonstrations, training sessions, and vendors. This workshop has grown each year with over 450 registrants at the latest workshop.

U.S. Army Environmental Command (USAEC)

Name: Assistant Chief of Staff for Installation Management

Reports to: ACSIM

Vision: We want to excel as the Army's point organization for implementing environmental programs that enhance Army training and operations while protecting the environment.

Mission Statement: As a field-operating agency of the ACSIM, we implement the environmental program for the Army by providing a broad range of innovative and cost-effective products and services in support of Army training, operations, and sound stewardship.

Goals/ Objectives:

1. *Sustainable Ranges*: Work at all levels to assure that the Army's land base is sustainable for Soldier training and weapons testing; provide integrated support to minimize mission constraints on Army ranges arising from environmental issues; support sound stewardship of natural resources; provide technical support and guidance, program and project management, and timely responses to emerging issues that threaten unimpeded use of ranges; focus on managing support for the Integrated Training Area Management Program and on helping the Army to seek opportunities to acquire encroachment buffers or new training lands; maintain the requirements process to develop scientific data and products to assist the Army in understanding and mitigating the environmental impacts of training and testing activities.
2. *Base Operations*: Work to integrate pollution prevention and environmental compliance into all aspects of base operations and promote the well-being of Soldiers, family members, civilian employees, and citizens of neighboring communities; concentrate on returning land contaminated by past activities to beneficial use or transfer by providing program guidance, planning, oversight and reporting for the Installation Restoration Program (active sites) and program management support for the BRAC Program; help ensure good management of cultural resources; manage installation environmental information by providing timely and accurate data to DoD and by providing technical and functional oversight of the Army's environmental data; seek to provide creative and cost-effective solutions for the Army's base operations challenges.
3. *Army Transformation*: Seek to find and implement innovative technologies to support the Army's

environmental program; enhance the Army's ability to design and field new equipment by incorporating life cycle environmental costs into the acquisition process; support Transformation initiatives by providing guidance and assistance to achieve timely NEPA compliance.

4. *Liaison and Advocate*: Proactively represent the Army's interests in developing Federal, regional, and state environmental legislation, regulations, and policy; seek regulatory or legislative changes when doing so will significantly support Army missions.
5. *Communications and Customers*: Cultivate external and internal collaborative processes and open communication, and establish communications plans that link environmental themes with those who depend on our support; actively communicate our mission and leverage partnerships both within and outside the Army; emphasize the internal business processes most necessary to achieve satisfaction with our customers at HQDA, installations (i.e., through the IMA and MACOMs), and acquisition program managers; we want to be known as an honest broker on environmental issues for the Army, credible throughout the Army and DoD, as well as with regulators and the public.
6. *Workforce Excellence*: Work to achieve a motivated, proactive, and professional interdisciplinary team recognized for excellence by providing supportive leadership and infrastructure; train and develop every member of our team to excel in current duties and prepare for increased responsibilities; seek recognition of USAEC for excellence in environmental programs, products, and services.
7. *Sound Business Practices*: Think and operate with a business mentality; work to ensure we are 100 percent mission-funded; focus on advocacy of corporate interests and return on investments of resources; emphasize cost savings as we implement the Army's environmental program, and achieve efficient use of resources by adhering to sound business practices while seeking innovative solutions.

Installation Management Agency (IMA)

Name:	Assistant Chief of Staff for Installation Management
Reports to:	ACSIM
Mission Statement:	Manage Army installations to support readiness and mission execution – provide equitable services and facilities, optimize resources, sustain the environment and enhance the well-being of the Military community
Goals/	• Support the warfighter and installations as "flagships"

Objectives:

- Sustain the well-being of Soldiers, family members, and authorized civilians
- Execute "Business Process Redesign" to maximize efficiency, effectiveness of services
- Enable mission commanders and Soldiers to focus on war front
- Assist Army transformation and the Army modular force
- Improve the Army's aging infrastructure and preserve the environment
- Communicate IMA goals to key constituencies within internal and external audiences; incorporate feedback from installations into conflict/resolution plans
- Support a 75,000 person work force with a budget of $8B.

Army Training Support Center (ATSC)

Name:	Army Training Support Center
Reports to:	Army HQ
Vision:	The Center of Excellence for Training Support
Mission Statement:	ATSC manages, plans, integrates, implements, and sustains specific Training Support System (TSS) programs, products, services, and facilities that support training across all training domains, TRADOC's core missions, and the Army.
Goals/ Objectives:	To serve as HQDA Executive Agent for: 1. Graphic Training Aids (GTA) Management 2. Training Aids, Devices, Simulators and Simulations (TADSS), including Tactical Engagement Simulation (TES) 3. Fielded Devices Inventory and Management 4. Training Mission Area (TMA) 5. Sustainable Range Program, including the Range and Training Land Program and Integrated Training Area Management (ITAM) 6. Standards in Training Commission (STRAC).

Army Regional Environmental Offices

Support the Army/DoD mission through coordination, communication, and facilitation of regional environmental issues and activities to strengthen community relations.

Joint National Training Center

Name:	Joint National Training Center
Director:	John Walsh, Assistant, Collective Training
Reports to:	Office of the Deputy Under Secretary of Defense (Readiness)
Goals/ Objectives:	1. Major Thrusts: 2. Improved Horizontal Training – Build on existing service interoperability training. 3. Improved Vertical Training – Link component and joint command and staff planning and execution. 4. Integration Exercises – Enhance existing joint exercises to address joint interoperability training in joint context. 5. Functional Training – Provide dedicated joint training environment for functional warfighting and complex joint tasks.

U.S. Army Special Operations Command (USASOC) Futures Center

Name:	Futures Center
Reports to:	U.S. Army Special Operations Command
Goals/ Objectives:	Continually forecast the future of the world and the military.

U.S. Joint Forces Command (JFCOM)

Name:	Joint Forces Command
Reports to:	Secretary of the Army
Mission Statement:	The U.S. Joint Forces Command provides mission ready joint capable forces, and supports the development and integration of joint, interagency, and multinational capabilities to meet the present and future operational needs of the joint force to: • support current operational needs • support the integration of joint, interagency, and multinational capabilities • support the development of future operational capabilities.
Goals/ Objectives:	• To improve the way we manage and provide forces and capabilities. • To enhance the interoperability of command and control so decisionmakers at all levels have the right information at the right time • To organize, train and equip Joint Task Force Headquarters

- To merge operations and intelligence so we can find the enemy and enable commanders to fix/finish/analyze and exploit
- To provide enabling capabilities that support the joint force commanders so that they can rapidly and effectively stand up their headquarters and execute their assigned missions.

A key issue at the heart of transforming joint military training, USJFCOM's Joint Warfighting Center continues to develop and implement the Joint National Training Capability (JNTC), which broadens and deepens the reach of joint force training. The Joint National Training Capability is providing an enhanced way to train that offers joint forces and the services a potential spectrum of live, virtual and constructive (L-V-C) training environments, where:

- Live = real people in real locations using real equipment
- Virtual Simulation = real people in simulators
- Constructive Simulation = simulated entities in a simulated environment.

JNTC provides an environment where every level of training is orchestrated within a joint context to provide the highest level of training for seamless future military operations. Events will target the following levels of execution:

- Horizontal: Service-to-service training to improve interoperability and joint operation issues
- Vertical: Strategic to tactical components joint training to improve vertical command integration
- Integration: Enhanced existing joint exercises to address joint interoperability training in a joint context
- Functional: Dedicated joint training environment to train to specific warfighting capabilities and complex joint tasks.

The long-term mission of this initiative is to incorporate service branches, interagency and multinational coalition partners. By 2009, the goal is to have the capability to train any audience—unified commands, services, multinational and interagency—in the full joint warfighting context. The persistent network will focus on joint training, experimentation, testing, education and mission rehearsal by linking command and control, training facilities, ranges, and simulation centers throughout the world.

2.5 Summary

The Army's current National land use strategy is primarily focused on protecting current military training lands–especially those located on the larger installations. The continual erosion of training and testing opportunities on installations due to urban growth and legislation is now being met with an array of studies, panels, programs, and resources to slow this critical loss. The BRAC 2005 plan increases the military footprint at several large installations (e.g., Benning, Carson, and Sill) and closes many small administrative installations – consolidating the activities by co-locating them on remaining locations. There are very few plans to expand military installations, with Fort Irwin being a rare recent example. The military, through the office of Economic Adjustment, helps installations develop Joint Land Use Studies with surrounding counties, own, and cities.

Recent Federal legislation allows military installations to partner with designated environmental organizations to purchase property development rights to provide buffer areas near installations. The Army has formalized its procedures through its Army Compatible Use Buffer program. The Army has also extended its evaluation of active installations by adding natural infrastructure ratings to its annual Installation Status Reports. All of these efforts, procedures, and investments are focused on preserving the ability of the Army to conduct its currently assigned missions.

3 The Need for a Future Army National Land Use Strategy

> The real battle for the Army is poor development of communities around its installations. It is time for one of America's great institutions to get engaged in the fight to help stem the tide of sprawl. If you lose an acre of fertile farmland to sprawl, you lose it forever; if you lose an acre of training land to sprawl, you lose it forever. And while the Army has excess installations and facilities, it is short on training land. The Army of the future is fewer, but larger installations. The land use requirements for a modern Army to house and train one Soldier has changed from 80 meters by 80 meters to 100 meters by 160 meters, in just the last 10 years.
>
> – Ray Clark. (2000). *Baseline* magazine.

At the time most installations were created, the possible locations where installations could be located were many. "Planning" meant simply selecting the best location. Now the prospect of locating a new installation seems nearly impossible and the military Services are in a phase of simply protecting what they have. Training has been curtailed at certain times of the day due to noise and entire training ranges and areas have been lost due to the combined restrictions placed on installations by local citizen groups and local, state, and Federal laws. It can be extremely frustrating to be responsible for the training of Soldiers while simultaneously meeting the constraints of rules, regulations, and restrictions that make the training less than fully realistic. Joint Land Use Studies, AICUZ, RAICUZ, ICUZ, INRMP, and other programs and studies are designed to maintain current installation missions in the face of many encroachment factors (Figure 1).

However, while the Army and DoD work to preserve the training/testing capabilities associated with current missions, the opportunities to expand capabilities to accommodate future requirements are silently disappearing. This represents a long-term challenge that our nation cannot afford to ignore. This section examines that challenge by looking at U.S. population growth, current DoD and Army transformation policies, future weapon systems and training requirements, and small battles currently being waged on the sidelines. These all point to the need for the an explicit future Army National land strategy that will carry the Army well into the 21st century.

3.1 Population Densities

Many of the encroachment challenges are directly linked to urban growth, which in turn is directly affected by: (1) population growth, (2) growing economic prosperity, and (3) inexpensive transportation. Population growth results in the demand for and construction of many more single-family homes, and the rapid expansion of cities. Figure 2 shows U.S. population growth through the 20th century (Hobbs and Stoops 2002). Population growth in the United States has been greatest in the western portion of the country (Figure 3).

Growing prosperity results in a decrease in the average number of people per household, which also results in an increased demand for more homes. Between 1990 and 2000, the average household size decreased from 2.63 to 2.59 (U.S. Census Bureau 2001) and then by 2005, to 2.57. Inexpensive transportation accentuates the trend by allowing people to live further from their workplaces, resulting in lower urban densities. Chicago's population density, for example, fell from 6,951 people/sq mi in 1950 to 3,914 in 2000 (a drop of nearly 44 percent). In 2000, 60 percent of the people in the Chicago metropolitan area live in the city's suburbs, primarily due to the easy availability and low cost of transportation.

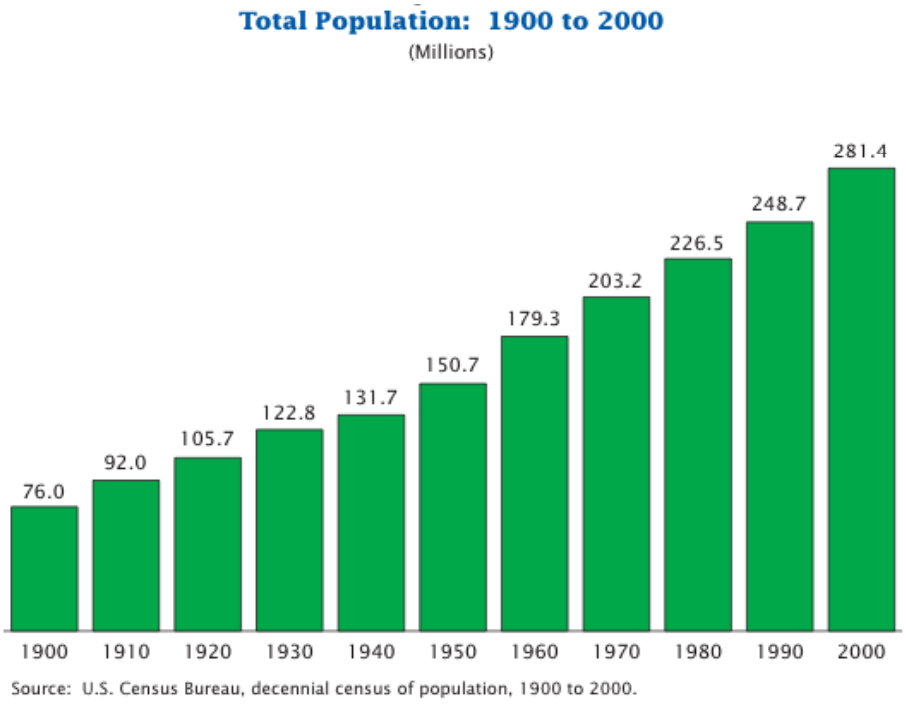

Figure 2. Total population: 1900 to 2000.

Increases in population, drops in the number of people per households, and drops in the density of major cities can result in increases in population near military installations. Figure 4 shows a U.S. Census Bureau map of U.S. population per square mile by county.

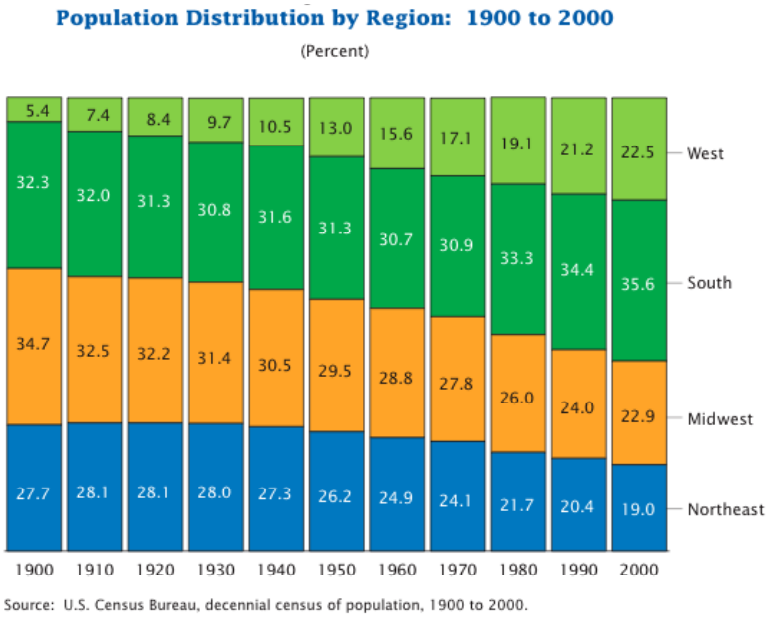

Figure 3. Population distribution by region.

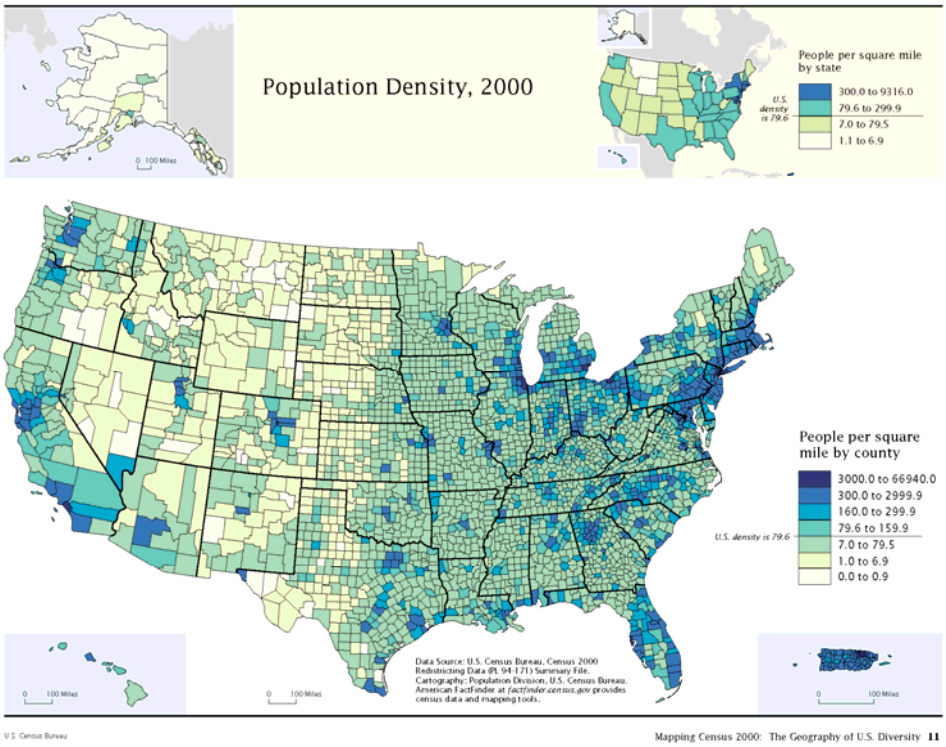

Figure 4. Population per square mile.

3.2 Natural Infrastructure

Urban growth has both direct and indirect effects on the operation of military installations. The direct effect of urban development on military installations is associated with complaints from neighbors due to noise, dust, smoke, and radio interference. Indirect effects can be even more important to an installation's survival. In particular, installations and neighbors share natural resources, which can be surprisingly limited. Example natural infrastructure include:

- air
- airspace
- land space
- drinking water
- habitat for important species
- waterways and oceans.

Figure 5 shows how military and civilian needs share and can sometimes compete for limited resources (Asiello 2005). Every region provides finite amounts of these resources and our collective use of them is becoming significant to the point of competition.

In September 2004, DoD Offices created the Installations Capabilities Council (ICC), composed of environmental representatives from OSD and service component representatives from the Secretariat and headquarters. The vision of the DoD Natural Infrastructure Capability (NIC) is:

> DoD Installations and ranges are available when and where needed, with the capabilities and capacities necessary to support the current and future warfighter.

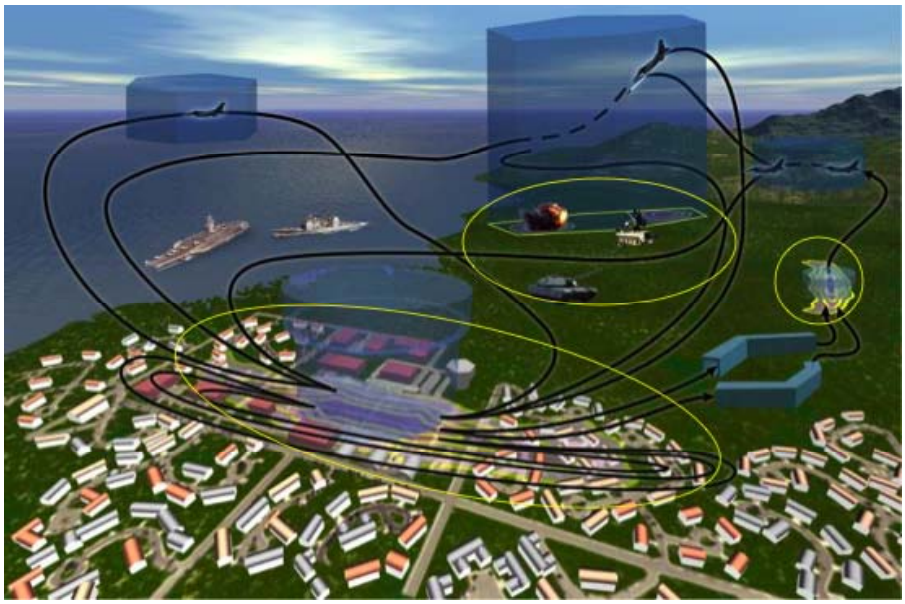

Figure 5. Illustration of "Competition for Natural Infrastructure" (from the 2nd DOD Sustainable Ranges Initiative Conference & Exhibition, San Antonio, TX, August 2005).

The NIC Mission Statement is:

> Provide, manage, and sustain, in an environmentally sound and legally compliant manner, natural infrastructure at installations and ranges to support joint and service-specific readiness and operations

The NIC goals are to:

- establish a common framework that brings a joint mission focus to natural infrastructure management
- develop the ability to measure the extent to which natural infrastructure meets mission needs
- enhance support of mission capabilities through natural infrastructure investment
- develop a joint mission capabilities-based, systematic approach to the planning, resourcing, and execution components of managing natural infrastructure assets
- ensure the equity associated with natural infrastructure assets is recognized and leveraged to effectively support current and future mission capability requirements.

The Department's interest in natural infrastructure is a direct reflection of the awareness that military installations sharing limited natural resources with regional neighbors and that together, installations and their neighbors collectively reach sustainable carrying capacities of some of these resources in some areas of the country. Figure 6 shows metrics developed for the NIC.

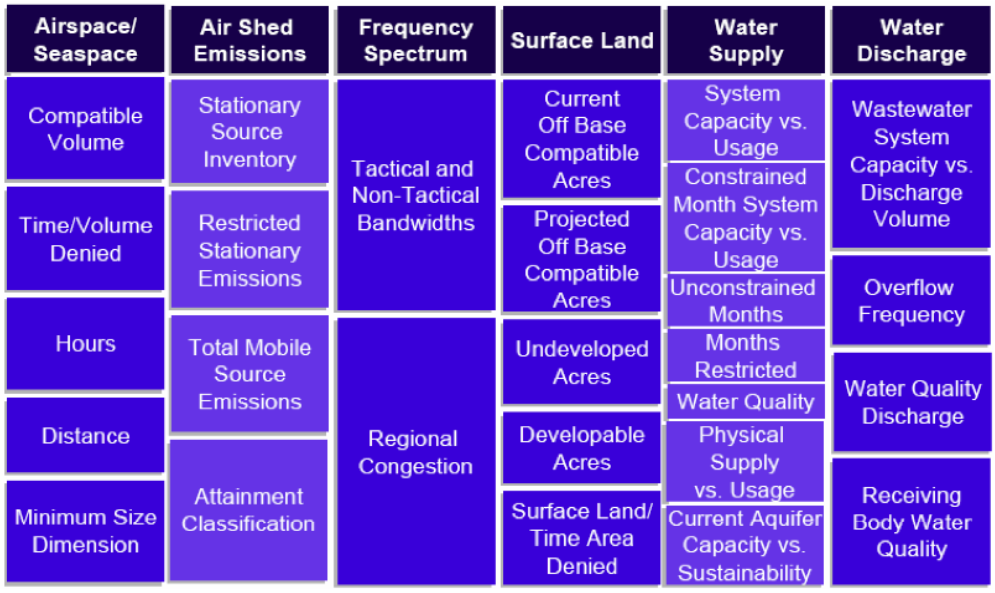

Figure 6. Sample NIC metrics.

3.3 Transformation Policy

> For many years, a focus on near-term operational risk resulted in short-changing preparations for the future. By the time pressing warfighting and readiness requirements were met, there was little funding or attention available for addressing the risk posed by less familiar and seemingly less urgent future challenges. September 11 made manifest the danger of postponing preparations for the future. We must prepare now to anticipate future surprises and mitigate their effects. During the Quadrennial Defense Review, the senior civilian and military leadership of the Department recognized the need to give greater emphasis to mitigating the risk posed by future challenges. Mitigating that risk requires investing now in many capabilities and forces that will not materialize for a decade or more. But we owe it to our posterity to begin a sustained process of investment and military transformation to meet and dissuade future challenges.
>
> – Donald Rumsfeld, Secretary of Defense. (2002). 2002 Annual Report to the President and the Congress.

Army

Figure 7 shows the cover of the U.S. Army 2003 Transformation Roadmap (DA 2003). This document begins by asserting that "The Nation requires a Joint Force that is full-spectrum dominant to meet the strategic mandates established by the National Security Strategy (NSS) ..."

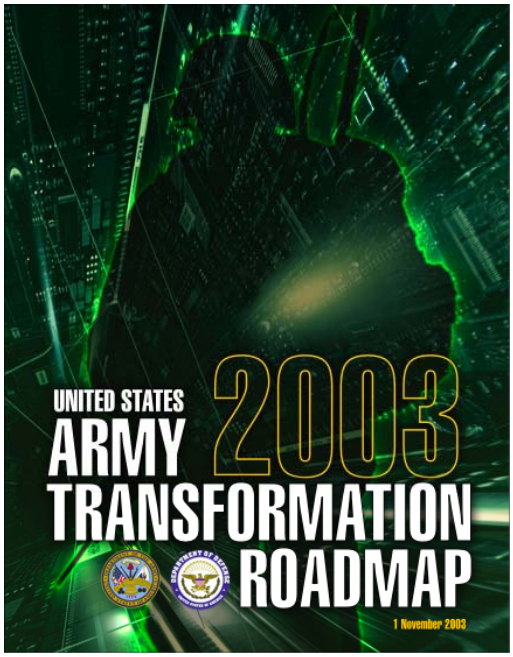

Figure 7. Army transformation roadmap.

The Army Transformation Roadmap (ATR) stresses that converting current forces to future forces is a continuous process of making the Army increasingly integrated, expeditionary, networked, decentralized, adaptable, decision superior, and lethal. The plan outlines many new weapon systems, sensors, and communication devices planned for the future force, many of which are being coordinated with the other services. These include the Future Combat System (FCS), many unmanned aerial vehicles (UAV), Aerial Combat Sensor (ACS), Stryker Brigade Combat Teams (SBCT), next generation helicopters (e.g., the Comanche), transport aircraft such as the SSTOL and HLVTOL platforms, high speed transport ships (e.g., the SDHSS), the Precision, Extended Glide Airdrop System (PEGASYS), precision munitions such as the Army Tactical Missile System (ATACMS) and Guided Missile Launch Rocket System (GMLRS), the High Mobility Artillery Rocket (HIMARS), and Excaliber, a cannon-delivered precision engagement self-guided projectile. In total, future weapon systems and associated training doctrine require increasingly large spaces for training and testing.

To help ensure the ability of installations to support the future force and future joint training, the Army, on 1 October 2002, established the Installation Management Agency (IMA), a field operating agency of the Assistant Chief of Staff for Installation Management (ACSIM). IMA's mission is to "provide equitable, efficient, and effective management of Army installations worldwide to support readiness, enable the well-being of Soldiers, civilians, and family members, improve infrastructure, and preserve the environment." In 2007, the Army established the Installation Management Command, which incorporated the IMA.

A Secretary of the Army memo established the Total Army Basing Study (TABS) Group supervised by DASA-IA (Infrastructure Analysis) within ASA-IE to inform the Base Realignment and Closure (BRAC) 2005 (White 2002). The memo title, "Transformation Through Base Realignment and Closure," indicates that the BRAC effort would support Army Transformation planning.

DOD

Each military service has a long history and honored tradition and competes to demonstrate its ability to fight for and protect the country. Their separation is rooted in an era when navies engaged navies, air forces battled air forces, and armies fought armies. Over time, warfighting needs changed. The need for combined Navy sea operations and Army land op-

erations resulted in today's Marine Corps. The need for the Navy to engage air capabilities for offensive and defensive operations resulted in a powerful air force within the Navy. The Army also relies on fixed and rotating wing aircraft to carry out its operations. The existence of the services as separate and nearly independent organizations ensured effective, but duplicated combined air, sea, land operations capabilities.

The current age of rapid communication, supercomputers, and large electronic databases invites the DoD to blend the historically independent services into one joint National service that combines the best of each of the services. During conflicts, up-to-the-moment top-level control of the integrated space, air, sea, land battlefield, combined with judicious decisions made with all the battle components, can result in a more lethal and decisive force. This is not a universally accepted idea; many service elements insist on keeping battle-proven organizational elements and doctrine in place. Many in the services are aware of the struggle between those demanding change and those that revere and honor the history-hardened status quo, and take the role of observers ready to change if and when directed to do so.

Today the DoD is moving fairly rapidly in the direction of a joint future through the implementation of the Joint National Training Capability (JNTC). Figure 8* depicts the notion of change from nearly independent services to a fully integrated JNTC. The end goal of this process is to provide the president and the Joint Chiefs of Staff with a wide array of military organizational parts that can be mixed and matched rapidly, efficiently, and effectively to address any military challenge in the world. This capability essentially blends the four military forces into one.

Under the JNTC concept, military units must be prepared to work across a broader range of situations and conditions and will therefore need to train accordingly. That is, current Navy, Air Force, Marines, and Army units will need to train alongside each other in ways that will, in many cases, require different and sometimes much larger training areas.

*Originally presented by MG Gordon Nash, USMC; Joint Force Trainer, USJFCOM (10 July 2003).

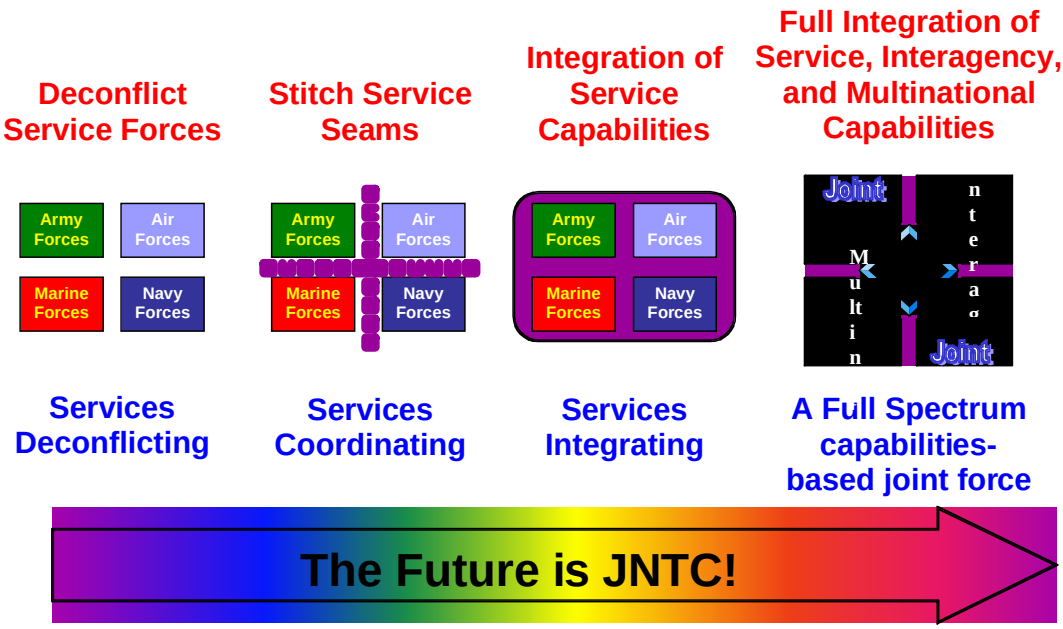

Figure 8. The Joint National Training Capability.

3.4 Larger Training Areas Will Be Required in the Future

> The Air Force looked at its future training range requirements based on its future weapons, and the problem is almost too hard to think about. When you think about directed energy–where are you going to use these weapons, and what are your restrictions on using them?
>
> – John Walsh, Senior Program Analyst for Training Ranges Another Programs in the Office of the Deputy Undersecretary of Defense for Readiness. (2001).
>
> The capabilities of new weapon platforms and systems that will appear in the services' inventories through the year 2025 are expected to exceed the range infrastructure.
>
> – Kauchak. (2001).

New Training Land Requirements for Future Weapons

Presentations at the 2006 Range and Training Land Program (RTLP) workshop considered future training land requirements. The RAND Arroyo Center considered the need to improve future training strategies for the Maneuver Brigade Combat Teams (MBCTs) equipped with Future Combat System (FCS) technologies in the 2010 to 2016 timeframe. Con-

clusions suggested that current planned enhancements to training capabilities will improve the training strategy, but these capabilities may be "significantly less than that demanded by future training requirements."

At the workshop, the TRADOC Systems Manager (TSM) for Unmanned Aerial Systems (UAS) and Fort Rucker considered the future training requirements associated with various unmanned air vehicles from the small Raven to the future Extended Range/Multi-Purpose (ERMP) system. The Raven is hand launched by a Company-sized unit for local limited-range reconnaissance. The ERMP will require an improved runway, will operate continuously for 36 hours and will fly to 25,000 ft. It will be able to carry weapons such as the Hellfire missile and will require extensive airspace and ground safety zoned areas for training. "In summary, each of the Army UAS could potentially require time and airspace on joint aviation range complexes to allow the supporting unit as well as the UAS unit itself to train effectively."

Future Army weapon systems include Directed Energy Weapons (DEW), which include high power radio frequency (HPRF), also called high power microwave (HPM), or RF-Directed Energy, laser, and particle beam systems (Figure 9). HPRF devices can reportedly generate some 2 billion watts or more in a flash that will destroy unprotected electronic circuits such as memory chips, computer CPUs, and communication equipment. Setback requirements from non-military areas can be enormous. Boeing is developing an Airborne Laser (ABL), a Chemical Oxygen Iodine Laser (COIL) system aboard a 747 to shoot down Scud-type missiles in their boost phase. Seven ABLs are scheduled for full operation in 2009.

Boeing's Rocketdyne division is developing a 70-kW COIL laser for the Advanced Tactical Laser (ATL), which can melt through steel at 1mm per second – making it effective against soft targets. It will be mounted on a variety of ground and air vehicles and has an operating range of 15 km. Satellite-based laser systems are also being developed for orbital deployment in 2012. Various particle beam and plasma weapons are also under development, though veiled in secrecy.

Locations such as White Sands Missile Range, NM, Kirtland AFB, NM, and "Area 51" (NV) allow for secret and safe testing of these high-powered DEW systems, but opportunities for training troops at or near current military installations with such systems must be considered long before the weapon system can be deployed.

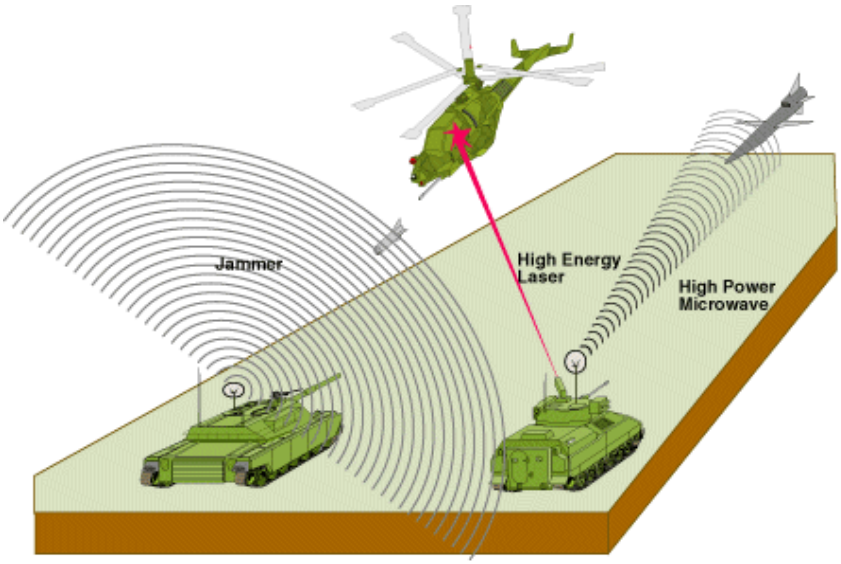

Figure 9. Battlefield applications of DEW and jamming - from http://www.fas.org/man/dod-101/army/docs/astmp/c4/fig4k1.gif .

Future Training Land Requirements

"Circling the wagons" to hold off the encroachment, while necessary to protect current missions, will not be sufficient to ensure the needs of the future transformed military. Appendix C of TC 25-1 (Headquarters Department of the Army 2004) states:

> Brigade and Battalion Commanders use a mix of Live, Virtual and Constructive (L-V-C) training to achieve and sustain unit and staff proficiency on METL and supporting battle tasks. Brigade size units rely more on V-C training to attain and sustain warfighting proficiency. Battalion size units attain and sustain their warfighting proficiency and develop Soldier fieldcraft primarily through live training. Smaller units train "in the dirt," using V-C training to prepare for live training or to retrain on critical tasks.
>
> Brigade Combat Teams (BCT) train to standard on full spectrum operations, which include offensive, defensive, stability and support operations. Commanders train units on the different forms of maneuver or types of defense within these operations, based on his assessment of unit proficiency and METT-TC.

TC 25-1 lays out sample maneuver training boxes to support Brigade Combat Team (BCT) (current force) training. Figure 10 shows a training box that accommodates all phases of training, but requires the activities to stop for troop repositioning. This 122,500 acre area must be expanded to a 172,000-acre area box (Figure 11) to allow a complete realistic free-flowing training activity.

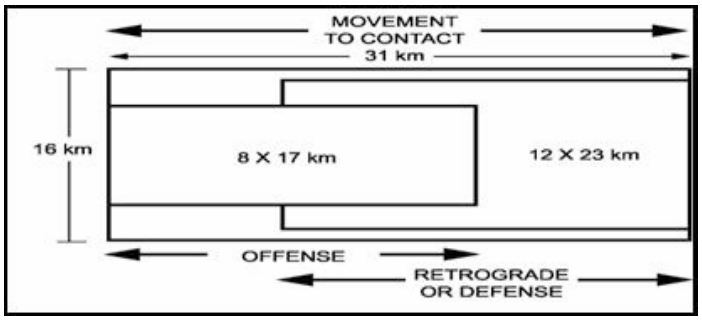

Figure 10. BCT maneuver/training requirements with stop/start setup.

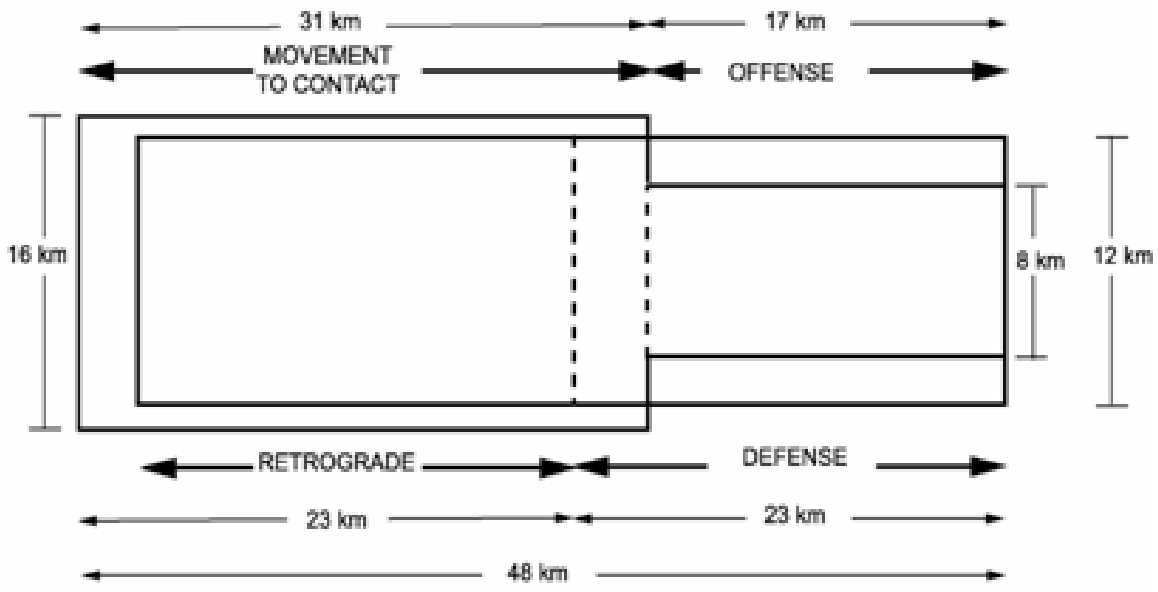

Figure 11. BCT maneuver/training requirements with free-flow training

A comparison of the required size of these training areas with the size of a few sample installations shows that these areas are clearly too large for most individual military installations to accommodate:

- National Training Center (NTC) (Fort Irwin, CA) 636,000 acres
- Fort Carson, CO 373,300 acres
- Fort Benning, GA 184,000 acres
- Fort Bragg, NC 150,000 acres.

Furthermore, the size of the battlefields in recent conflicts has grown significantly. A brigade battlefield that was an 8x12 km area in WWII expanded to a 50x65 km area during Operation Iraqi Freedom (Fatz 2003).

The brigade battlefield is not only large and growing, but training areas of that size must be available in a variety of habitat and environmental condi-

tions. Currently, Fort Irwin's National Training Center (NTC) is the premier heavy maneuver Combat Training Center designed for force-on-force brigade-sized military training. Fort Irwin is located in the desert of the southwest United States. This level of training is not available in the United States in any other climate or habitat setting.

The brigade battlefield is, by itself, insufficient for large joint force training exercises. To address this challenge, DoD has created the Joint National Training Center, which integrates 29 Palms, CA, Fort Irwin, CA, Fort Polk, LA, Nellis AFB, NV, and Navy range complexes on the east and west coasts. Training events include Roving Sands, CAX, NTC, JRTC, Red Flag, and JTFEXs (Figure 12).

3.5 Future Installations – Larger or Patchwork?

Current installations are, by themselves, inadequate to effectively test future weapon systems and train the service and joint forces. Anticipated future weapon systems including fixed and rotary wing aircraft, unmanned aircraft, high energy weapons, artillery, and various smart weapons can require safety areas and fans that exceed the availability at many locations. The transformed military requires a tighter integration of the capabilities across services and across nations.

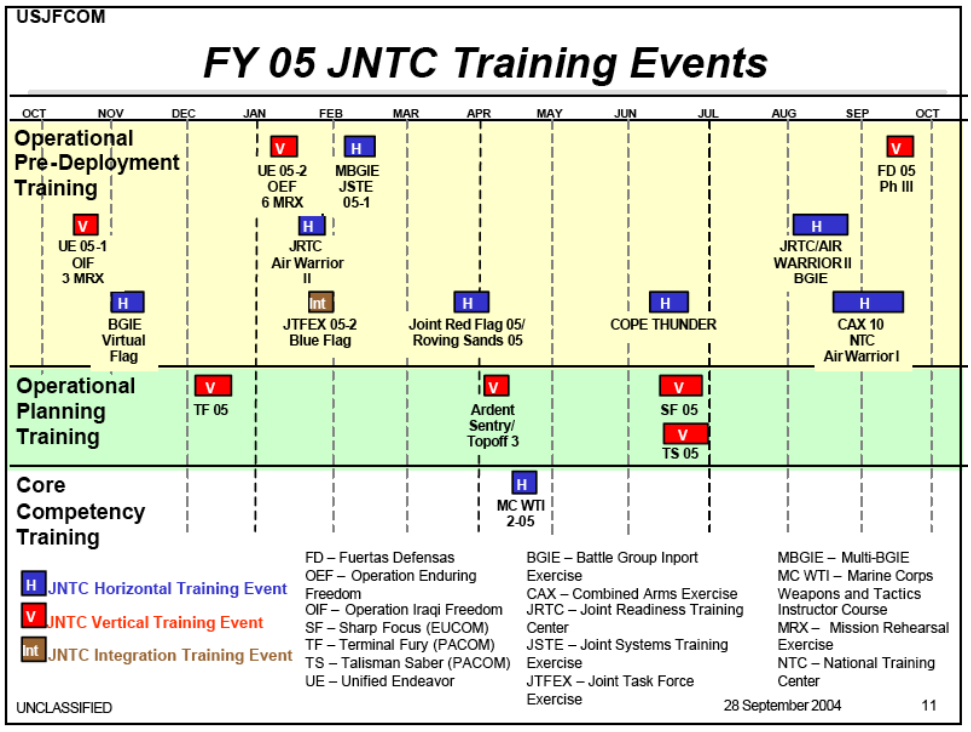

Figure 12. FY05 JNTC training events.

To fully prepare, military units must train in extensive exercises that require far more space than is generally available. While contiguous space might be available at Fort Bliss and White Sands, the cost to move troops from across the nation can be prohibitive and the training experience might not match the location in the world where troops might be dispatched. That is, desert training might not be appropriate to prepare for jungle or arctic operations.

Recognizing this land and cost challenge, the DoD is applying the L-V-C approach to training, employing computer simulations and situations that can be used separately or in conjunction with live training. While there is an expanding use of virtual training in the Army, some have indicated that the learning impact of e-learning has been hard to measure (Park 2005). DoD also continues to expand its training land by acquiring new land contiguous to existing training areas (e.g., the expansion of Fort Irwin). In addition, new buffer initiatives authorize DoD to partner with environmental organizations to purchase property development rights in threatened and endangered species areas to help alleviate pressures on installations to protect remnant populations within the training areas.

Another approach to increasing the training capabilities and capacities is to make more use of geographically disconnected regional training assets. Consider the generic diagram in Figure 13, which is reproduced from TC 25-1. Four grey areas in a broader region provide training areas connected by roads (and perhaps air and water), which allow a single training exercise to make use of a broad set of training opportunities. The grey areas could be separate, existing military installations; perhaps multi service. They could be any of the following:

- National parks
- BLM land
- National forest
- State parks
- Private timber land
- Private farm land
- Abandoned urban areas (brownfields)
- County parks.

Fort Rucker provides an example of how the Army has worked with local communities to effectively extend the effective geographic range of the installation by creating staging areas across the surrounding region. The image from the DISDI portal in Figure 14 shows Fort Rucker near the center outlined in green. The small green areas across the region are staging areas, some of which are associated with noise contour zones in orange. The large grey area that covers most of the image is a flight zone associated with Fort Rucker, “The Home of Army Aviation.” Coordination with the local communities and municipalities is required to support both the flight zone and staging areas.

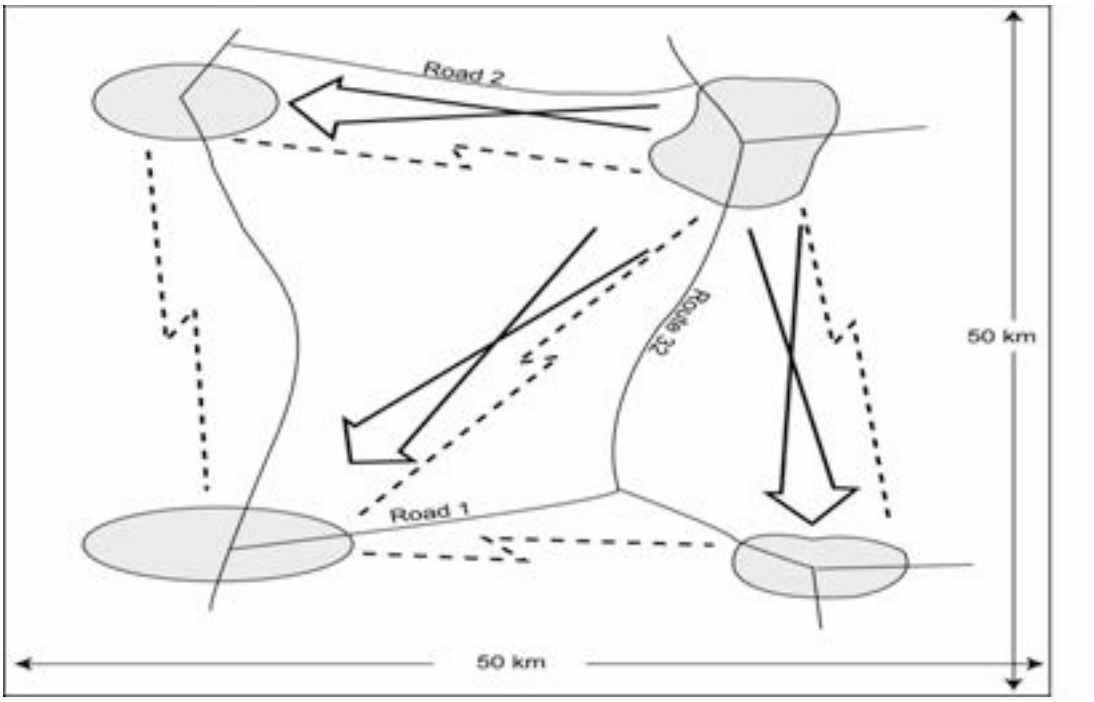

Figure 13. TC 25-1 patchwork diagram to meet training needs.

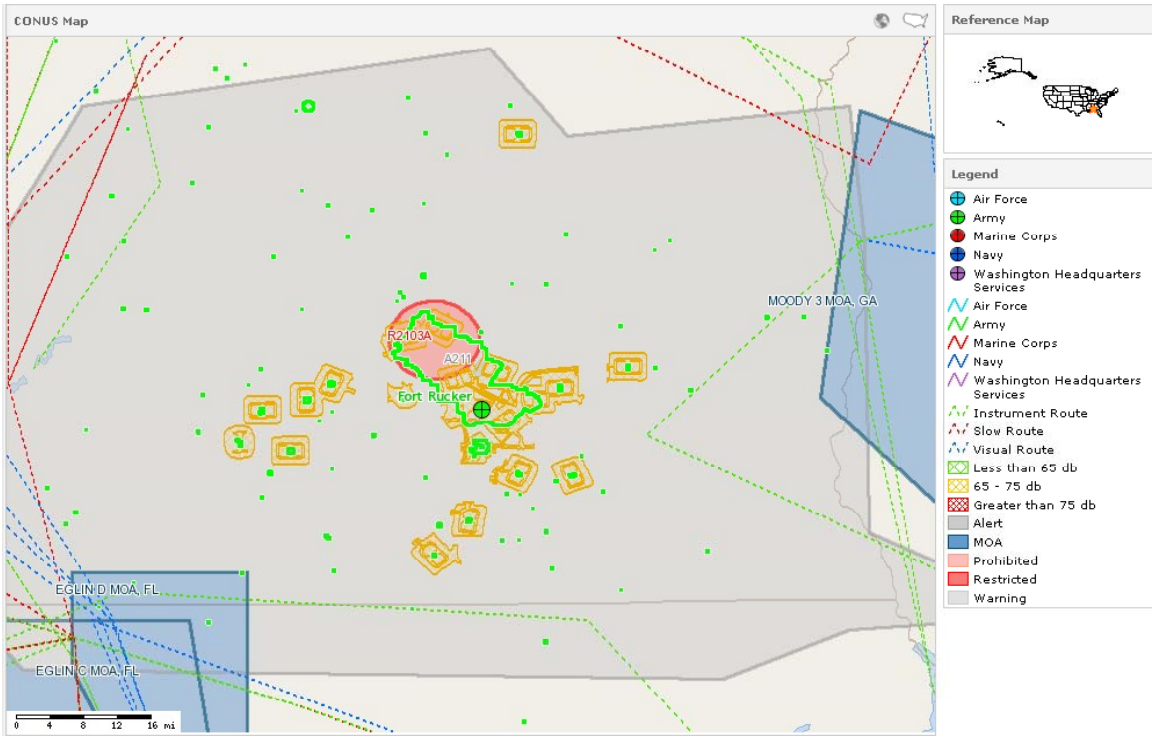

Figure 14. Fort Rucker's use of regional training opportunities.

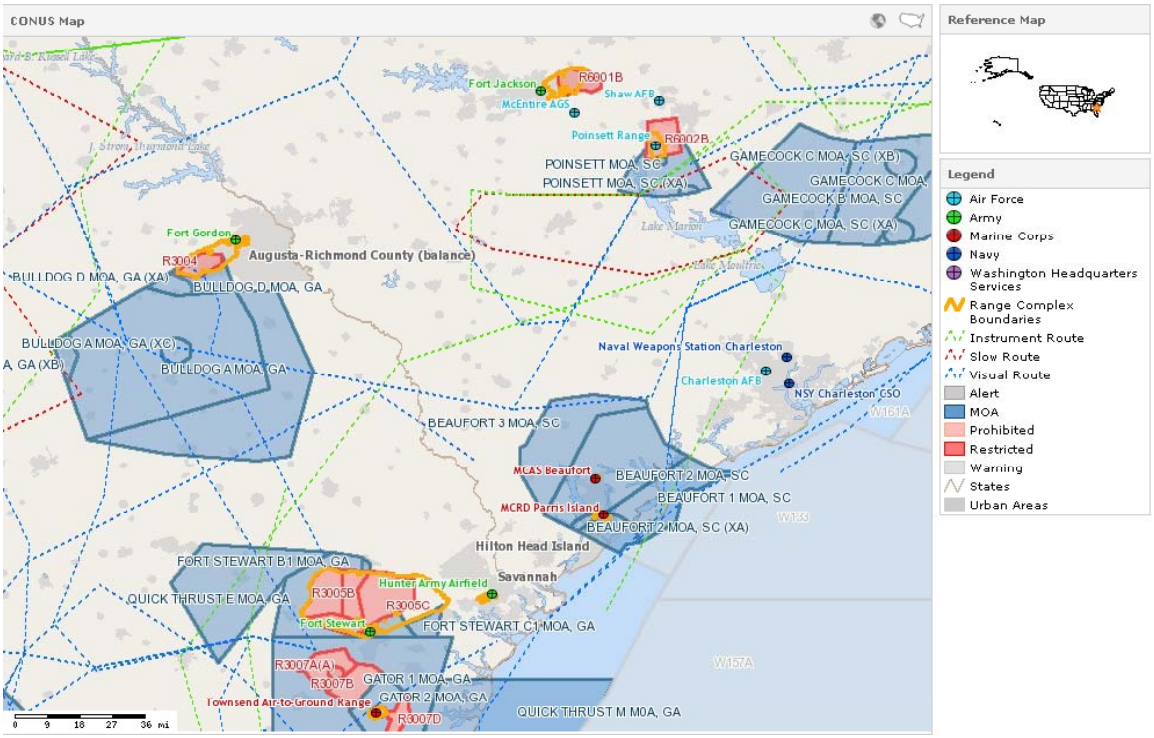

Figure 15. Example co-location of multiservice installations.

This approach to training can and does extend to include joint training across multiple services and multiple installations. Clearly, for example, the opportunities to coordinate training among co-located multiple service installations is substantial in the South Carolina–Georgia area. Figure 15 shows three Army installations, two Navy, three Air Force, and two Marine Core installations (with others just outside the area). Several military operating areas (MOAs), restricted airspaces, and flight routes combine the installations to provide significant joint exercise opportunities.

3.6 Regional Training Exercises

Desert Scimitar

Desert Scimitar was a week-long exercise that integrated Marines from the Combat Center and Camp Pendleton, and tested command and control procedures, fire support coordination and maneuver operations with the use of infantry units ended here 27 March 2002. This type of exercise, commonly referred to as a "Tactical Exercise Without Troops" (TEWT), was performed on a larger scale during Desert Scimitar; many TEWTs only involve companies or battalions, but Desert Scimitar involved a large portion of the 1st Marine Division..

Approximately 600 vehicles and 2,700 Marines participated in the military exercise, which was conducted from 22 April through 3 May 2002. The Marines set up Command Operation Centers, retransmission sites, and assembly areas in strategic designated areas. Desert Scimitar '02 allowed the Marines to operate in unfamiliar terrain, test new communication systems, conduct a river crossing, and test the coordination required to move a division-level convoy of personnel and equipment. The convoy departed from the Twentynine Palms Marine Corp Base and traveled on existing roads throughout the training exercise, which concluded in Yuma, AZ. The training exercise did not include:

- live or simulated fire
- pyrotechnics, smoke, or obscurants
- aggressor forces
- physical engagements
- off-road or "free play" maneuvers
- tracked combat vehicles
- nighttime exercises.

The California Bureau of Land Management (BLM) prepared an environmental assessment (EA) analyzing any potential impacts on the public lands (available through URL: http://www.ca.blm.gov/palmsprings). Jim Kenna, Palm Springs-South Coast Field Office Manager of the BLM, confirmed that: "The BLM is proud to provide the public lands for use in these efforts of maintaining our nations security, while continuing BLM's mission to sustain the health, diversity and productivity of the public lands for the use and enjoyment of present and future generations."

Roving Sands

http://www.forscom.army.mil/interop/rs2.htm

ROVING SANDS is a Chairman, Joint Chiefs of Staff (CJCS) directed, U.S. Joint Forces Command (USJFCOM) sponsored, U.S. Army Forces Command (FORSCOM) executed joint interoperability training exercise that focuses on Joint Theater Air and Missile Defense (JTAMD) and Joint Tactical Air Operations (JTAO).

Field Training Exercise (FTX) ROVING SANDS is the world's largest joint theater air and missile defense exercise. It provides unique training opportunities to U.S. joint and multi-national participants in Joint Tactical Air Operations (JTAO) Interface operations, joint operations, air defense and

joint interoperability, while simultaneously achieving unit-training objectives. Because the aircraft force ratio is designed to heavily favor the opposition force, friendly forces must develop an integrated air defense system and execute coordinated management of joint air defense assets to succeed. The opposition force, comprised of a variety of unified coalition aviation elements, plans and executes joint strikes against a joint and combined integrated air defense system.

FTX ROVING SANDS focuses on planning and executing JTAO integrated air defense of a Joint Task Force (JTF) during a contingency operation. The exercise lasts approximately 2 weeks.

This Total Force Exercise coalesces the participation of all four Services and their National Guard and Reserve Components. In addition, multinational participation is ever increasing. Primary players include Army Air Defense Artillery (ADA) Brigades, Navy Carrier Air Wings, Marine Air Control Groups, Air Force Theater Air Control System (TACS) units, and a wide variety of combat aviation units from the four Services. Joint logistics and communications support is provided by various Service units.

Joint Red Flag

U.S. Joint Forces Command (USJFCOM) sponsored Joint Red Flag 05 (JRF05), one of that year's premier joint training events, 14 March through 1 April 2005 to evaluate how the Department of Defense will conduct operations in the future.

One of USJFCOM's four component commands, the U.S. Air Force's Air Combat Command (ACC) at Langley AFB, VA acted as the executive agent for Joint Red Flag 2005 (JRF05). ACC linked a number of traditionally separate training events and locations, primarily at Nellis AFB, NV, Kirtland AFB, NM, Fort Hood, TX, and Fort Bliss, TX.

One key to combat effectiveness is to "train forces as they are going to fight." Ensuring interoperability was one of the key goals of JRF05. By integrating and enhancing several exercises normally run by the individual services, the training audience is better prepared to address joint interoperability issues before deploying to a joint environment.

More than 10,000 members from the U.S. armed forces, reserves and National Guard, special operations forces, and other government agencies

participated in the event. Several coalition partners played major roles as well, both as participants and observers.

Adding virtual and constructive forces to the event significantly enhances the interoperability training opportunities while minimizing the costs to the taxpayers. JRF05 used the Joint National Training Capability (JNTC) to link live, virtual, and constructed (L-V-C) forces and create a computer-simulated battlespace distributed to sites across the country. Live forces consist of real people and real systems in a live environment, while virtual forces consist of real people participating in simulators. Constructed forces are computer generated.

3.7 Future Strategy

> There's no substitute for real-world, finger on the pickle button bombs coming off, missiles coming off type of training. You cannot simulate that.
>
> – Office of Economic Adjustment JLUS video.

Components of the Army's current National land use strategy will remain critical for the foreseeable future. These include:

- educating and engaging local municipalities and landowners with respect to the natural infrastructure needs of our installations
- promoting local, state, and Federal regulation that require landowners to consider military needs and to disclose the military use of air, space, and noise zones to prospective buyers
- promoting regional, state, and local joint land use planning
- purchase of development rights through the ACUB program for protecting threatened and endangered species to allow for military testing/training
- developing increasingly realistic and sophisticated virtual and constructive environments.

In addition, the Army must add to its strategy components that ensure the availability of land to provide live training opportunities to Soldiers being trained to fight future battles using future equipment and future tactics. The above strategies are aimed at preserving installations and their training/testing capacities; but the future will undoubtedly require more land that is currently fenced at most installations. Therefore, the explicit strategy should include the following components:

- projections of the land required to accommodate potential future weapon systems and brigade-level, joint service, and joint nationality training
- identification of potential, but as yet unused, training areas
- coordination with local, state, regional, and National lawmakers to protect these potential areas from development that would preclude their future use
- execution of research programs to identify social, economic, ecologic, environmental, and military approaches for planning that optimizes potential future joint, distributed, regional training capacities.

4 Potential Research Topics

The Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL) research community was invited to submit "five-page pre-proposals" that would become part of this report. The assignment to each interested individual was to propose research topics that should be conducted within ERDC to support the Army's ability to train on land or water, or in the air using resources outside of the direct control of the Department of Defense. Since its creation, the Construction Engineering Research Laboratory, co-located with the University of Illinois at Urbana-Champaign, has focused on providing solutions for more effectively managing Army installations. The Army, as part of the Future Force, will need to conduct training exercises that require spaces well beyond those available at most Army installations. Therefore it is prudent to expand the scope of ERDC-CERL's historical within-the-fenceline traditional focus to one that embraces the notion that outside-the-fenceline training and testing opportunities will become increasingly relevant.

4.1 A Community Look at Proposal Ideas

The premises behind the consideration of a Joint Distributed Regional Training Capabilities R&D program and some proposed research efforts were presented to an informal panel at a meeting hosted by IMA-SERO, Fort McPherson, Atlanta, GA on 17 March 2006. Table 1 lists the Participants in this meeting. One researcher (James Westervelt) presented and administered a survey on Army requirements (Appendix A).

Table 1. Panel meeting participants.

Participant	Organization
Manette Messenger	IMA-South East Regional Office (SERO)
George Carellas	Southeast Regional Environmental Office (SREO)
Elizabeth Keysar	CTC
Rudy Stein	SERO Environmental Chief
Brent Gaffney	SERO
Dennis Calbreath	SERO Master Planning
Stu Cannon	FORSCOM
Dana Perkins	SERO BRAC
Marshall Williams	SREO
Karen Baker	AEPI (by phone)

4.2 "Pre-Proposal" Content

The following sections of this chapter include R&D "pre-proposals" that seek to identify promising areas of research relevant to future Army training and testing requirements. Authors were invited to organize each "pre-proposal" into the following sections:

- *Relevance* Identify the military need and relevance
- *Objective* The intended result from the proposed research
- *Approach* What will be the general steps
- *References* What academic literature has been cited in the above
- *Cost* A gross estimate of cost over how many years
- *Developer(s)* The author(s) of the proposal.

In total, these pre-proposals provide a statement of research and development, science and technology opportunities to ERDC to support the expanded training and testing that will be required by the Future Force. Subject areas covered include social systems, endangered species, invasive species, optimized use and scheduling of available natural and human infrastructure, regional planning, and advanced construction.

4.3 Effects of Military Training on Archaeological Sites

Relevance

Ongoing developments in military vehicles, weapons systems, and training scenarios have increased the need for large, continuous tracts of land for military training. Like other agencies, DOD must comply with Federal laws that require the identification and management of historic and cultural resources. The Army's strategy for managing archaeological sites (the most common type of cultural resource in the training lands) has been based on avoidance. Given the broad distribution of archaeological site across the landscape, the site avoidance strategy has severely fragmented the lands available for training. Joint distributed training on non-installation public or private lands offers one option to meet new training needs. Unfortunately, archaeological sites would pose similar restrictions for joint distributed training. Research is proposed here to investigate the actual effects of a wide range of military training activities on a number of site types. Objectives of this research are to advance the discipline's understanding of site transformation processes (Schiffer 1987), and to improve the effectiveness of DOD management practices.

Background

Prehistoric and historic archaeological sites are widely distributed across the landscape in virtually all portions of the United States. More than 90,000 sites have been documented on military installations (including 64,000 sites on training lands), and ongoing archaeological surveys identify of roughly 5,000 new sites each year (Lee Foster, personal communication, August 2006). Archaeological sites are, in many cases, scientifically important because they provide a record of variation and change in past human behavior and culture. A relatively small percentage of sites also have great cultural significance, particularly those that contain evidence of ritual activity or ancestral burials of modern Native American groups.

Archaeological sites are locations where past human activities are manifest by artifacts and/or features (constructed facilities such as domestic architecture, pits, hearths, and graves). The scientific and cultural value of an archaeological site is closely related to the integrity of its cultural deposits (Little et al. 2000). Just as disturbance to a recent crime scene can compromise the reliability of inferences about the events that occurred there, disturbance of an archaeological site can diminish the site's depositional integrity and potential value as a source of information about past human

behavior. Efforts to understand the history, social identity, and cultural practices of past social groups require information from sites that represent many time intervals, locations on the landscape, functional site types, etc. Thus, it is essential to preserve many sites, not simply a few representative examples.

Federal law (National Historic Preservation Act of 1966 as amended) requires Federal agencies to take into account the effects of their undertakings on historic properties that are or may be eligible for the National Register of Historic Places (NRHP). One of the goals specified in the Army Strategy for the Environment's is to enhance the well-being of Soldiers, civilians, neighbors, and communities by celebrating our heritage "through responsible management of our cultural resources." In short, Federal law and Army policy clearly require the proper management of archaeological resources that may be impacted by military training and related activities, both on installations as well as on non-DOD public and private lands that might be used for training.

Evaluating a site's NRHP eligibility status often requires test excavations designed to evaluate the site's integrity and significance relative to established criteria (Little et al. 2000). When a site is determined to be eligible for the National Register, the agency must make an effort to either avoid or mitigate adverse impacts. Sites whose eligibility has not yet been determined must be afforded the same protection as those that have been found to be eligible for nomination to the NRHP. Mitigation of adverse impacts, which often involves a program of data recovery, analysis, and report preparation, is rarely practiced because of its high costs. Site avoidance is DoD's primary management strategy. The practice of avoiding numerous, widely distributed sites severely fragments the large tracts of land needed for realistic military training. In the absence of adequate evidence to the contrary, state regulatory authorities (the State Historic Preservation Office) typically assume that most military activities will result in adverse impacts to sites and therefore advocate site avoidance. In reality, it is likely that many types of military training could be conducted with little risk of adverse impacts to archaeological deposits.

Previous Research

Studies focused on how archaeological deposits are modified by modern cultural practices make up a relatively small portion of the literature on how archaeological sites are formed and transformed (Schiffer 1976, 1983, 1987; Schiffer and House 1977; Spoerl 1988; Wildesen 1982; Wood and

Johnson 1978). Of particular relevance are a modest number of studies (selected examples are referenced here) focused on the impacts on archaeological resources of military pedestrian traffic (Whitecotten et al. 2000), bivouacking (Trumball et al. 1994), the intentional or inadvertent use of fire (Kelly and Mayberry 1980; Switzer 1974), livestock grazing (Osborn et al. 1987), mechanized removal of vegetation (DeBloois et al. 1974; Haase 1983), land leveling (Ford and Rolingson 1972; Medford 1972), erosion (Boardman and Bell 1992; Davidson et al. 1998; MacDonald 1990; Wainwright 1992, 1994), vandalism (Christensen 1988; Hargrave et al. 1998; McAllister 1991; Nickens 1981; U.S. General Accounting Office), and modern agriculture (Frink 1984; Lewarch and O'Brien 1981).

Few Federal land-managing agencies impact their archaeological resources as intensively as the Army. The intensive military training that is essential to combat readiness places great stress on available training lands. The Army has developed sophisticated methods for predicting and mitigating the effects of training on soil, ground cover, and threatened and endangered plants and animals (e.g., AEC 1999; Sullivan and Anderson 2000). Unfortunately, very little research has focused on the impacts of military training on archaeological sites (Carlson and Briuer 1986; Johnson and Campbell 2004; Meyer and Hargrave 2003; Richardson and Hargrave 1998; Zeidler and Isaacson 2001; Zeidler 2003). Reports of archaeological investigations conducted on military installations often note that sites have been impacted by vehicle traffic, the excavation of fighting positions, or the construction of unpaved roads. Such studies rarely attempt to quantify the extent to which such impacts diminish the potential for recovering scientifically useful information from those sites. (See Hargrave et al. 1998 for an effort to quantify the impacts of looting on site stratigraphy.) State regulatory officials thus tend to view military training as a monolithic undertaking that is likely to result in adverse impacts to archaeological sites. This view underlies the Army's general practice of attempting to avoid archaeological sites during most training exercises.

Objectives

Research is needed to understand and quantify the *actual* impacts of military training on various types of archaeological resources. Note that the emphasis here will *not* be on the issue of how discrete military training events (such as the use of specific vehicle types) cause particular impacts in particular soils, moisture conditions, vegetation covers, slopes, and so forth. The nature and magnitude of such impacts can be predicted with satisfactory reliability using the ATTACC (Army Training and Testing Area

Carrying Capacity) software tool. ATTACC is widely used by the Army's ITAM (Integrated Training Area Management) program to predict land maintenance and rehabilitation requirements based on actual environmental conditions and training load (AEC 1999; Ayers 1994; Ayers et al. 1990; Braunack 1986; Prose 1985; Wilson 1988).

The proposed research will address the question of how military training impacts (ruts, compaction, erosion, etc.) degrade the scientific and cultural value of diverse archaeological deposits. Examples of transformation processes directly associated with military training impacts include:

1. Vertical and horizontal displacement of artifacts caused by rutting, compaction, and erosion can alter stratigraphic relationships that represent primary evidence of the temporal and functional associations among archaeological deposits.
2. Fragmentation of artifacts can obfuscate evidence of use (e.g., edge wear on lithic artifacts) and reduce the reliability of estimates of the number and morphology of individual specimens (e.g., ceramic vessels, faunal elements, lithic tool and debitage categories).
3. Compaction and displacement of sediments can complicate or preclude the reliable interpretation of analytically important deposits such as macro- and micro-artifacts associated with house floors, other features, or activity areas.
4. The aforementioned processes can diminish the potential to evaluate the depositional context and unmixed status of carbonized materials potentially suitable for radiocarbon dating.
5. The introduction to a site of metallic trash can complicate or preclude the use of archaeological techniques such as metal detection and geophysical survey.
6. Efforts to remediate rutted sites by grading or intensive disking can have effects similar to those described in items 1-4.

These and other impacts potentially associated with military training clearly have the potential to degrade the depositional integrity, scientific and cultural value of archaeological sites. Note, however, that few of the archaeological sites located on military installations are in anything resembling pristine condition. Many archaeological sites in the eastern United States were subjected to decades of historic cultivation prior to their acquisition by the military. Historic plowing tends to have impacted the uppermost 20-30 cm, with deeper impacts occurring if chisel plows are used. Although plowing destroys the stratigraphic (vertical) relationships among artifacts, studies have indicated that the amount of horizontal

movement is modest (Baker and Schiffer 1975; Knoerl and Versaggi 1984; Lewarch and O'Brien 1981; Robertson 1976; Roper 1976; Trubowitz 1978). Thus, key issues include the extent to which military training activities would disturb sub-plow zone deposits or cause lateral displacements greater than those associated with plowing. Similar questions concern near-surface deposits in western regions where plowing has not occurred but grazing, erosion, and previous military vehicle impacts have been intense. The nature and intensity of adverse impacts are expected to vary based on the details of military training activities, archaeological site type, local climate, environment, and history of land use.

Approach

The research proposed here will focus on four tasks:

1. Identify and quantify the factors, processes, and interaction effects by which military training impacts can degrade the integrity and scientific value of archaeological deposits. This work will include field investigations at sites that have been previously impacted as well as experimental impact studies of actual sites (that have been determined to be not eligible for the NRHP) and simulated deposits. Use of simulated deposits will provide an opportunity to quantify the effects of processes such as horizontal and vertical displacement of artifacts in particular soils using various vehicle types, etc.
2. Develop indices of site vulnerability to damage from training impacts. Sites will vary in terms of their vulnerability to different training impacts based on variation in soil, vegetation, moisture, slope, nature (e.g., depth) of archaeological deposits and impact intensity. For example, soil compaction is more detrimental to sites with near-surface architectural remains than to lithic scatters that are restricted to plow-disturbed strata.
3. Use the vulnerability indices in conjunction with extant actual and predicted site distribution data as a basis for developing guidelines for acceptable training types, intensities, and seasonal (e.g., soil moisture and temperature) conditions. It is anticipated that the research will find that some training activities have little or no adverse effect on the integrity and research potential of archaeological deposits, particularly when conducted under appropriate conditions. It is also expected that some site types will require continued avoidance.
4. Develop automated support tools that will allow installation training and cultural resource management programs to integrate site vulnerability into their management of training lands.

The variables that will play key roles in this study (soil, vegetation, slope, moisture regime, types of training impacts, and characteristics of archaeological deposits) exhibit substantial geographic variation. It will not be feasible to develop vulnerability indices for all possible combinations of these variables. This project will focus on a relatively small number of combinations of site types and training practices that currently account for the greatest restrictions on military training.

To date, no systematic attempt has been made to quantify the relationships between military training impacts to a site's soil and vegetation and degradation of the integrity and scientific value of its archaeological deposits. Of all Federal agencies, the Army clearly has the greatest motivation for such research, given its need for intensive training on finite land resources. While other Federal land managing agencies (e.g., the Bureau of Land Management, Department of Transportation, National Park Service, Forest Service) will benefit from this research, the Army will realize the greatest benefits from the anticipated reduction in restrictions on training. It is unlikely that any other agency or research community would undertake research like that proposed here.

While a majority of the professional archaeologists in the U.S. are employed in Cultural Resource Management arena, CRM generally relies on university-based research (often in other disciplines) for technological and methodological advances. Most academic archaeologists have little motivation for initiating research into the effects of military training on site integrity. Academic archaeological research is typically focused on theoretically-informed investigations of social processes and/or reconstructions of particular prehistoric developmental sequences. University researchers understandably seek out sites with well-preserved cultural deposits that are highly relevant to their particular research questions. In short, while the research proposed here will benefit CRM programs in various Federal and state agencies, the Army will realize the greatest benefits, and no one other than the Army is likely to fund such research.

Science and Technology Content

The research program outlined here would yield significant advances for the discipline of archaeology. The study of site formation and transformation processes has fundamental relevance to nearly all archaeological investigations. To date, very little research has been focused on the issue of how military impacts to a site's soil and vegetation cover degrade the integrity and scientific value of its archaeological deposits. Such degradation

is a major concern for the Army in terms of both its cultural resource stewardship responsibilities and its need to maximize the use of available training lands. The extent of such degradation—and the magnitude of costs associated with mitigation efforts—will play an important role in assessing the costs and feasibility of joint distributed training on non-military lands.

The proposed research would also have broad implications for archaeological resources in the United States that are increasingly threatened by intensified agricultural practices, urban expansion, road construction, and a growing, international market for looted antiquities. Results of the proposed research would thus be of wide interest to many university and CRM-based researchers and resource managers. The Army research community clearly has a significant motivation and unique opportunity to assume a leadership role in this area of research.

The proposed research would be executed by a multidisciplinary team with expertise in military training, soil science, botany, and geology, as well as various sub-disciplines of archaeology (paleobotanical and zooarchaeological taphonomy, lithic and ceramic analysis, CRM). Research would involve small scale, highly focused archaeological excavations and experimental studies using actual and simulated archaeological deposits. Research findings would be infused into the military training community via automated (software) tools. The research program would be led by a team comprised of researchers at ERDC CERL with research partners from ERDC GSL, university, private sector, state (State Historic Preservation Office) and Federal regulatory agency (Advisory Council for Historic Preservation, National Park Service) communities.

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4.4 Characterize Training and Testing Needs of Future Systems

Relevance

Military training and testing land requirements are based on: (1) weapon systems, (2) training doctrine, and (3) frequency of training/testing. Today's installations are accommodating the land requirements and are being augmented with increasingly more computer-based training and testing, which help reduce environmental impacts, fuel costs, and equipment repairs. Future weapon systems and doctrine can dramatically change the training and testing requirements imposed on environmental, economic, and social systems. Knowing the potential land requirements allows the Army and other services to proactively acquire, arrange, and protect future needed landscapes.

Objective

The objective is to identify what training and testing lands are likely to be required in 2050 and beyond.

Approach

There are five fundamental steps required to achieve the objective:

1. Weapon systems that may be in use in 2050 need to be identified. This exercise must be somewhat fanciful so that actual planned weapon systems need not be revealed and the full range of possibilities can be explored. Weapon systems must include manned and unmanned air, land, and water vehicles; miniature networked devices that provide sensor and weapon capabilities; various directed energy systems including electrical, magnetic, and atomic particles; future artillery and rocket systems; and future CBR systems.
2. Future doctrine options must be considered. Doctrine is driven by the combination of military threat and weapon system capabilities. The current military force transformation steps continue to point towards larger self-contained units that bring together components that have traditionally been associated with different service elements. This and other visions of the future must be considered.
3. The safety requirements associated with each proposed weapon system must be developed. These include direct and indirect human impacts and consequences to natural ecosystems – with special consideration of threatened/endangered species (TES) and species at risk (SAR). Fourth, the natural resources require to test and train-with the system

in a manner that meets training doctrine needs and safety requirements can be developed.

4. The natural resources of the country can be evaluated to identify where each weapon system type could be potentially used in training and testing.

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4.5 Maintain Readiness by Improving Regional Training Capacities: Development of Regions of Military Influence

Relevance

Military training is carried out to ensure readiness of the armed forces. The challenge is the sustainment of realistic training on military installations. Army commanders must sustain the Army's capability to give Soldiers the ability to succeed through the full-spectrum of possible operations (Lillie and Martin 2003).

Maj. Gen. Robert Van Antwerp stated in congressional testimony in March 2001 that "encroachment" is impacting the Army's use of its training ranges and consequently affecting military readiness (Burlas 2001). Encroachment is defined as "the cumulative impact of pressures placed on military installations and ranges and the surrounding communities and environmental controls resulting from growing development and urbanization around military facilities, increasing regulatory burdens, and competition for air, land, water, energy, radio spectrum, and other resources." Many decades ago, military posts were established in rural areas. Now, maneuver and live-fire exercises and flights by military aircraft have created civilian complaints of dust, smoke, and noise. In some cases, these issues have resulted in limiting the hours when and where training can occur.

Encroachment has also reduced the amount of wildlife habitat around military bases such that these posts now contain "islands of biodiversity." Compliance with requirements to protect Threatened and Endangered Species (TES) limits the use of many training ranges. In his 2001 congressional testimony, Maj. Gen. Robert Van Antwerp remarked that there are 153 Federally listed endangered species found at 94 Army installations.

While space available for training is diminishing, technology continues to expand the operating footprint for military units (Environmental Update, Summer 2001). The Army has increased needs to train with faster vehicles and more powerful weapon systems.

The recent Quadrennial Defense Review (OSD 2006) states that the Department of Defense is transforming. Senior leaders of this Department view that transformation as a shift of emphasis to meet the new strategic environment. One shift in emphasis mentioned in the QDR is from separate military Service concepts of operation – to joint and combined opera-

tions (OSD 2006). But existing military installations do not possess the size or range of conditions needed to fully exercise joint training mission objectives.

Desert Scimitar is the name of an annual 1st Marine Division field exercise traditionally carried out at the Marine Corps Air Ground Combat Center (MCAGCC), Twentynine Palms, California. The limited size of MCAGCC and Yuma Proving Grounds (YPG) and other military lands in the area did not allow the 1st Marine Division to meet its command and communication training needs (Bureau of Land Management 2002). Nor did the existing military installations allow for deployment of a floating bridge to test river-crossing capabilities. The planners of Desert Scimitar exercise sought ways to test and train the Division's command and control element under conditions more representative of the distances and terrain they would encounter in battle. The exercise planners sought to use lands outside the military installation boundaries on which to conduct this exercise.

Desert Scimitar in 2001 took place almost exclusively on public and private lands. This pilot program was considered a success. The exercise was well received by the local populace, and received favorable press. The exercise objectives were met which validated the importance of this type of training for the Division command element. The training area for the Desert Scimitar 02 exercise spanned two states, an interstate waterway, five BLM field offices (Palm Springs, El Centro, Barstow, Needles, and Yuma), and two military reservations (Yuma Proving Ground and Marine Corps Air Ground Combat Center (MCAGCC).

Purchasing additional land to train on and test weapons appears not to be a viable option for the military (although, perhaps, this thinking should be challenged). "[W]e acknowledge we're likely not to get a lot more space to do our operations," said Rear Admiral Mark Boensel, commander for the Navy Southeast region in an April 28 interview (Defense Environment Alert May 2006.)

Thus, identifying regional training capacities can be one option to increase installation training opportunities and to sustain military readiness.

Objective

The objective is to identify "Regions of Military Influence" and assess the conditions therein.

Background

Most land use decisions are local. The military seeks to be engaged in land use decisionmaking so that the military interests are represented. DoD has a need for increased training capacities, which means training on lands that DoD does not own or control. State and local governments maintain responsibility for land use planning, environmental regulation, and enforcement on these nonmilitary lands. Thus, the sharing of air, land and water resources dictates the need for partnerships between three primary stakeholders: the military, state/regional/local agencies, and local land use jurisdictions (ECOS 2004).

As an encroachment initiative, the Army is partnering with conservation groups to facilitate the acquisition of land outside installation boundaries to create buffers against urban development. DoD and the four southern states of North Carolina, South Carolina, Georgia, and Florida have entered into a pilot Regional Partnership for Planning and Sustainability. The objective is to develop "a framework for better collaboration with each other and non-governmental organizations (NGOs) and others to make informed land use decisions that help deter conflicts over military testing and training and nearby land uses" (Defense Environment Alert 2006).

The Northwest Florida Greenway project protects a 100-mile corridor in the Florida panhandle connecting Apalachicola National Forest and Eglin Air Force base. It is a partnership of military, government, and nonprofit organizations with the aim to conserve critical ecosystems in one of the most biologically diverse regions in the United States, enhance the Panhandle's economy, and help protect the military mission in northwest Florida.

The Private Lands Initiative is an Army conservation partnership with private, nonprofit conservation organizations to meet conservation goals and restore Army Access to training land. In this project, Fort Bragg provides funding for the partnership, The Nature Conservancy (TNC) acquires deeded interest in suitable properties for species recovery, and TNC provides Fort Bragg with access to acquired properties to conduct compatible military training in accordance with conservation agreements (Lillie and Martin 2003).

Approach

A "Region of Military Influence" is a new strategic planning concept that can be elaborated upon to ensure that military missions can be sustained on a regional basis throughout the country (DoD OEA 2005). Establishing a process and determining the data requirements to enable regional planning allows the military to take further advantage of the various ongoing piecemeal initiatives (i.e., Northwest Florida Greenway Corridor, Central Texas Sustainability Partnership).

Regional indices that define current and joint military land use requirements would be needed. For example, identify the climate, terrain, and hydrology representative of the distances and terrain required by the military to execute training missions. Also, define military-friendly areas (possibly by counties) with respect to developed social, economic, and legal indices.

Applying a comprehensive, regional planning approach to sustaining and increasing military training and testing opportunities would also enable analyses of future military training land use requirements.

Also, having established a comprehensive process to plan for the needs of military training in a regional context would facilitate obtaining the support and cooperation of numerous Federal, state, and local agencies and private landowners, prior to an actual training exercise taking place. Also, NEPA analyses, when required, could be fast tracked through early identification of requirements and impact analyses.

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4.6 Social Impact of Occasional Regional Training Exercises on Communities

Relevance

To ensure readiness of the armed forces, the military must train. Thus, using land and resources around local communities can be one option to increase installation training opportunities and to sustain military readiness. There have been successful uses of land between the military and surrounding communities. Some of these are: Desert Scimitar, Sustainable Fort Bragg, Sustainable Sandhills, Northwest Florida Greenway and Fort Hood. Do we know the social and/or economic impact of this? What if we used a community occasionally? What if we came in trained and then left? Used the community for a weekend, 1 week, 2 weeks or a month?

Objective

The objective of this pre-proposal is to identify "Social Impacts of Training on Communities" and assess these. One of the major challenges to the training needs of the military is the availability of training areas. Finding adequate training and testing areas is challenging. The military has looked at and is still investigating several ways to accomplish this.

The ability to use dedicated lands, seas, and airspace to maintain mission readiness is being impacted by dynamic social and land use changes all across the world (Westervelt 2003). To preserve future training needs and capabilities, it has become necessary to purchase/rent or borrow land from local communities. The community and the installation needs to take a closer look at what can and should be done to enable both entities to work together. What we do not know are the impacts on the communities. Also, what if there was occasional training in a particular area? What are the social/economic and environmental impacts on the city, county, or state during that time? Additionally, there would be an economic impact on the local community and the extent of that impact should be determined.

Approach

This work will begin with a review of the studies/projects that have already been done.

Review the process that the military used working with the local communities in the other projects. Including environmental, social and economic issues.

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4.7 Training in Real Urban Environments

Relevance

> The new battlespace of the 21st Century will be in an urban environment compared to the wars of the 20th Century, which were largely fought in farmers' fields. Currently the MOUT (military operation in urban terrain) facilities do not represent the theater operations in the Middle East. "National Defense Panel review in December 1997 castigated the [U.S.] Army as unprepared for protracted combat in the near impassable, maze-like streets of the poverty-stricken cities of the Third World. As a result, the four armed services, coordinated by the Joint Staff Urban Working Group, launched crash programs to master street-fighting under realistic third-world conditions. 'The future of warfare,' the journal of the Army War College declared, 'lies in the streets, sewers, high-rise buildings, and sprawl of houses that form the broken cities of the world.'"
>
> – City states: IUS Blog.

In the past we trained for a war that was focused on the conventional warfare of the European landscape. Our doctrine focused on the potential conflicts with the Soviet Union in European and stopping the spread of Communism in Asia, Latin American, and Africa. As the resources of the world become scarce, there is a general population migration from the country to the city. It is estimated that by 2025, 85 percent of the world's population will be living in the cities and megalopolises (Stanton 2000).

There are two factors that Soldiers will face in the future. First, wars will continue to be fought in the urban environment. Secondly, the "cultural phase of war where intimate knowledge of the enemy's motivation, intent, will, tactical methods and cultural environment has proven to be far more important for success than the deployment of smart bombs, unmanned aircraft and expansive bandwidth" (Scales 2004, p 2). The ability of the Soldier to not only be perceptive enough to gather information from the surrounding environment, but also understand that training for battle must also include training for the pre and post battle in an urban environment. The concept of the "three block war" is that Soldiers will have to provide humanitarian work, stabilization operations and low-to mid-intensity combat within the same day. Thus the cultural intelligence of the battle space with a focus on pre- and post-hostilities is critical to and more important than the traditional intelligence preparation of the battle space (Smith, p.21). George J. Mordica II, an analyst for the Center for Army Lessons Learned believes that "the training we are using to prepare our

Soldiers for urban combat is not realistic enough to present the full spectrum of command and control, along with the psychological impact, close combat, and logistical problems associated with this kind of combat" (Morales, Internet). In the book *Black Hawk Down*, Bowden (2000) recalls the intense story of the brave Special Forces Soldiers asked to conduct a mission in an urban setting that quickly spun out of control. The mission in Mogadishu was for U.S. troops the most recent incident of Urban Warfare since the battle of Hue during the Vietnam War (O'Neill 2003). The battle in Mogadishu brought out some key problems of urban combat:

- Urban Navigation ("How is it that a nation that could land an unmanned little go-cart on the surface of Mars could not steer a convoy five blocks through the streets of Mogadishu?")
- Urban Communication
- Civilians intermixed with fighters
- Cultural Intelligence.

Objective

The objective of this work is to develop a process that can effectively and efficiently identify cost-effective locations to support future MOUT training areas.

Existing urban settings are a real (not replicated) setting that can provide actual environmental and spatial problems for training. If it is agreed that actual urban settings are the best possible setting for training Soldiers in urban-based conflicts, the question then is of the availability of such places. It is our opinion that these places exist, are ideal locations for training, and the communities where they exist may welcome the economic redevelopment opportunities that will come with the creation of such training sites.

Approach

We must study the construed and cultural urban settings for which Soldiers must be trained. We must then study the physical and economic opportunities available within the United States to meet these needs. Training in existing urban centers with careful consideration of their locations (clearly and historically declining urban areas), might serve as an opportunity to economic boost to the local community while meeting the training needs of the Army. "The economically, politically and socially driven processes of creative destruction through abandonment and redevelop-

ment are often every bit as destructive as arbitrary acts of war. Much of contemporary Baltimore, with its 40,000 abandoned houses, looks like a war zone to rival Sarajevo" (Harvey 2003, p 26). So why not use it as an urban training facility to meet the needs of the Army and the redevelopment of the inner city?

The U.S. Army currently uses inner-city hospital trauma units as a live training ground for its battlefield physicians (Clark 1994). We can conclude then, that the Army values the role of the urban environment to train its physicians.

Just recently, from 30 April to 6 May 2006, the Canadian Armed Forces with the involvement of 40 American military personnel engaged in an urban warfare training exercise in the streets of Winnipeg, Canada. The training website was called "Operation Charging Bison" and the purpose of the training was to provide the full spectrum of the three block war of securing stability, humanitarian aid, and rebuilding. For more detail, see website:
www.army.forces.gc.ca/38cbg_hq/Headquarters/G3/exercises_operations/charging_bison_04/charging

Possible urban training locations exist. Two prime examples come readily to mind given our knowledge and experiences. East St Louis, IL (ESL) is a historically declining urban setting. The population of the city has experienced a sharp decline in population (55 percent in the last 10 years) over the last 3 decades include a 55 percent decrease in the last 10 years. Efforts to reverse this trend are on-going, although some localized efforts have succeeding stemming the decline, the overall area remains in economic downturn.

- ESL is located in St Clair, County, IL, across the Mississippi from St Louis, MO and in close proximity to Scott AFB for easy air lift in-and-out activity.
- The existing building stock remains, although at much reduced prices. Because of the large vacancy rates and declining demand for infrastructure, the building is extremely undervalued and is far less expensive than newly constructed facilities. This may present opportunities for purchase.

Questions of the efficacy and social equity of such a purchase remain problematic. How this type of purchase would be perceived is difficult to ascertain without careful analysis. It is our opinion that the redevelopment op-

portunities in terms of possible jobs, Soldier housing and related needs that would follow such a training site would be attractive to the local community. These could be presented in joint public-private partnerships that would serve as local economic development opportunities. The social dimension, especially considering the large minority and economically challenged segments of the East St. Louis population, remains obscure and in need of study.

Other sites for the type of training exist in all climate zones of the United States. New Orleans is another good example. The catastrophic effects of Hurricane Katrina have elicited a debate on the viability of rebuilding large tracts of the city. In some districts, returning to homes and businesses has been determined to be too environmentally risky. The risk, however, may be in daily activity and residency, not in training. The infrastructure exists; the plan may include large tracts of this infrastructure to remain fallow. It might be tractable as a service urban warfare-training site. This would provide a win/win for the community and DoD.

The opportunity for the Army to practice and train the "three block war concept" in a real urban environment is a real benefit that should be overlooked. By retrofitting live urban training building facilities to reconfigurable modifications based on cultural characteristics, for example such as correct door widths and heights, street widths, and building heights, will allow training Soldiers to establish a level of comfort and spatial awareness with the urban battlefield and speed up situation awareness on the ground.

A more culturally accurate urban environment facility will better address the first four Joint Urban Operations principals:

1. Help the Soldier understand the complex urban environment.
2. See first, see clearly, and see in depth.
3. Control the urban environment.
4. Isolate the adversary (JUO 2004; Tooker 2006).

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4.8 Developing a Process for Community and Installation Communication

Relevance

It is apparent that one of the major challenges to compatible development near military installations is the ability of the local/surrounding communities and an installation to develop a process for communicating about and implementing a process for planning to ensure the positive development of both the communities and the installation.

The mission of the installation is of the utmost importance to that installation and the ambiance and the development are of the utmost importance to the community. Embedded in these issues are the specific points of mission change, the development of newer, different needs of the installation as the needs of training and testing change over the life of an installation. Coinciding with the things that are happening "within the fences" of an installation, the community is often growing toward those fences, either by actual residential and/or business developments, or via parks and recreation sites.

Installations also have run into challenges with neighboring/surrounding communities because of the impact of noise and other real and perceived threats to the "quality of life" envisioned by the community. As the military has grown and expanded, become more modern and experimental in fighting urban wars, the needs for training and testing have changed and expanded.

The communities neighboring an installation(s) historically have been "in the area," but most often not immediately next to the fence. As communities have grown and developed, they often have grown into becoming the "next door neighbor." This has caused concern regarding quality of life issues, and has caused both the community and the installation to take a closer look at what can and should be done to enable both entities to work together to build a strong plan.

Many installations and communities have begun to work on developing strategic plans that included both groups. Many have held conferences to work on the issues that each group is concerned about. However, there seems to be a concern that the continuance of thinking about the important issues – to both the military and the community – change as the

commanders change at the installation and the elected officials change within the community.

Why This Should Be Studied

There have been many planning and study sessions between communities and installations. Many hours have been spent in this area. However, it would seem that it is time for the Army to develop a specific process for them to use to work with communities as they look at the current and future needs of specific installations.

Commanders need to be able to reach out to specific people within the Army that are trained in communicating and working with communities that have identified or have been identified by the Army to be having a need to work in this area. These persons would be trained to look into the future (25–30 years) to understand from the Army's perspective where it will be in that time, where the community needs and wants to be in that time, and then to begin to work with each group to enable them to talk about, work on and develop appropriate plans.

Objective

The objective of this work is to develop a better approach than those currently available that ensures effective planning through inter-community and installation communication techniques. Many factors need to be taken into account in this area:

1. Most importantly, from the Army's point of view, the mission and/or possible changing mission of the installation.
2. The current and future needs of the community need to be addressed; considering the community's own plan, but also considering the influence and needs of the installation. Population growth and/or possible decline is a factor.
3. A variety of factors impact both groups in this study, including (this is not a complete list):
    a. Regional setting and other issues within the region
    b. Environmental goals
        (1) Habitat
        (2) Species
        (3) People
            (a) Transportation goals
            (b) Facility goals
            (c) Future development goals

c. Quality of Life Goals (including the communication issue: "How to sustain the relationships between the surrounding communities and the installation over time," i.e., who to go to, how to keep it going, etc.).

As the Army and the Communities look at their current state and their future state through these and many other factors, it is important to remember that, as the problem of encroachment enters the picture, all of the activities of both the installation and the community need land in some form of activity, and those needs often conflict with one another.

Therefore a strong commitment to open and successful communication and understanding of both sides needs to be developed. There needs to be specific training and education for the persons responsible for this interaction between the two groups. Additionally there should be a determined effort from both sides to work hard and diligently together to form a working group, plan, and mindset to help the process happen.

Approach

Four primary steps are required:

1. Review Army training materials, doctrine and other appropriate information to determine what is now available in this arena.
2. Review the planning process available to communities as they work with the Army and specific installations.
3. Determine if there are appropriate people with appropriate skills available in the Army to help with the future planning – 25 – 30 years – as related to communities and surrounding areas.
4. From this information, develop a plan of action for building a cadre of people within and outside the government to implement the development of this communication/training/awareness/plan.

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4.9 Context Specific Military-Unique Delivery of Real-Time Geospatial Information Products

Relevance

In all aspects of the Army's missions in peace-time or war there is a need for Context Specific Military-Unique delivery of Real-Time Geospatial Information Products to the War Fighter at all command infrastructure levels. To successfully accomplish a Joint Distributed Forces Training Exercise over an area as large as a multi-state region demands efficient delivery of military-unique real-time geospatial information from the squad level up to higher headquarters. With the development of Internet Services and wireless technology, handheld devices are becoming the standard platform for receipt of this information. However, there still exists a void in Internet Service development and standards that does not adequately address context specific military unique geospatial information.

More importantly a standard from which to build the ability to gather this information in a "real-time" context has only recently been developed. Until 03 May 2006, there was no standard governing how Real Simple Syndication (RSS) would apply to geographic information. Real Simple Syndication was initially developed by Netscape in 1999 to deliver web syndication of news-oriented web feeds. Web syndication refers to providing the most updated form of a web feed on news that is available from the news site that is being linked too. In essence an Internet service using RSS monitors the update frequency of a service that is responsible for the distribution of geospatial data. The moment the content of that geospatial data is updated, the RSS Internet service transmits the new content to the receiving service, which could be an interface developed for PDAs to inform unit level commanders of the movement and positions of surrounding threats. Initial development of RSS to support the transfer of geospatial information did not follow a smooth path.

Early attempts to handle the transfer of geospatial topology with RSS used proprietary architectures making cross platform interfacing cumbersome and slow defeating the purpose of what RSS was designed for, which was near real-time to real-time data delivery. As a result the Open Geospatial Consortium (OGC) a multi-member University and Industry research group open to all, undertook the development of an open standard that would enable seamless transfer of Geospatial topology and attributes across all platforms allowing RSS to reach its full "real-time" data feed po-

tential. This standard, termed GeoRSS was recently debuted at a Locational Services conference in Cambridge, MA.

What is urgently needed now is research to develop context specific military unique real-time geospatial web services to meet the needs of the Joint Distributed Regional Training Mission. Context Specific as defined by Brezillon (2003) is "the information that characterizes the interaction between humans, applications, and the surrounding environment." In terms of Army training this could be a need to know community activities in towns and cities that would serve to inform or permit modeling and simulation of activities directed at achieving good community relations while the exercise is in process. To accomplish this, Internet GIS Services must have the ability to translate information collected in real-time into an appropriate military training context that is acceptable to communities while also maintaining training realism.

Commercial web services do not have a military training perspective or context and cannot accommodate this unique situation. This requires a research effort by a group that has a long history of developing geospatial technologies for Army training. The ERDC has a long list of geospatial credits accorded to it from the GRASS GIS System to its most recent Fort Future research efforts. The ERDC understands the Army training mission requirements and the intricacies involved. Through the success of this research effort, the Army will have the ability to deliver context specific real-time geospatial information where it is needed and across any platform that uses wired/wireless Internet services.

Objective

The objective of this research is to develop distributed GIS web service prototypes that will establish the new "state of the art" in future distributed GIS web service capability. The nature of a Joint Distributed Regional Training Mission will require a complete re-evaluation of current GIS technologies in an effort to address the complexities of executing a training exercise over and through the public landscape. The GIS products currently used by training land managers are not sufficient to address the incorporation of direct public interaction into the training domain. Not only are current technologies woefully incapable of this task, but they are also incapable of incorporating modeling and simulation logic into the "real-time" decision support stream. Current "real-time" GIS technologies simply provided straight sensor-based data updates to static map outputs.

The frontier that this research is embarking on is to develop GIS web services that incorporate simulation and modeling algorithms that seek to interpret "real-time" GIS data streams to avoid and appease public obstacles to a Joint Regional Training Mission Exercise. Accomplishing this will require a completely new look and perhaps new development of distributed web service architecture to facilitate this new generation of GIS web services that will deliver "real-time" decision support GIS products to all levels of presentation platform.

Approach

To accomplish this research will require a multi-phase, multi-year effort. Phase I Year one will involve:

- a thorough analysis of Army Training exercises within the Joint Regional Training Force structure with respect to their ability to cause public disruption or annoyance
- analysis of distributed web service architecture identifying the technology gaps where development needs to take place to incorporate all aspects of multi-platform distributed GIS Internet service delivery and integration of decision support modeling and simulation.

Phase II Year two will involve:

- development of distributed GIS Internet services that characterize the Army Training Exercises and associated spatio-temporal specific data needed to conduct decision support analysis for avoidance of potential public obstacles to training activities
- development of technology needed to fill gaps in distributed Internet service architecture identified in Phase I Year one analysis
- development of decision support modeling and simulation based on data inputs supplied by context specific Army training exercises and public real-time spatio-temporal data feeds.

Phase III Year three will involve:

- development to integrate Phase II research products into a comprehensive distributed Internet GIS service prototype delivery framework for Army JDRTC public problem avoidance product
- beginning a beta-test of integrated framework and GIS service prototypes.

Phase IV Year four will involve:

- concluding a beta-test and developing solutions to problems identified in beta-testing
- Integrating solutions into a framework and GIS service prototypes
- tech transfer to 6.3 program.

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Cost

Year I	250K
Year II	350K
Year III	250K
Year IV	200K
Total	1,050,000.00

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4.10 Optimal Training of Army Forces Using Regional Assets

Relevance

The Future Force is expected to train over long distances using weapon systems that fire over the horizon, travel light and fast, and must be practiced as part of large exercises that involve multiple services. While very little land is available for creating a contiguous installation within which all necessary training/testing can take place, smaller areas remain available across the landscape that can be "patched" together in a manner that allows realistic mission support activities. Regional assets include air space, travel corridors (roads and rail), maneuver areas, bivouac locations, and aircraft landing areas. These assets are likely to be available only during certain times of the year, month, week, or day, and they need to be scheduled in a manner that meets the training objective and the needs of the surrounding communities and municipalities.

Objective

The objective is to develop capabilities that evaluate current and future options and conditions of natural and man-made infrastructure in a region to automatically and optimally design training exercises that are acceptable to military trainers and those who live and work in the region. This requires capturing spatial and temporal information about the region's current and future landscape, weather, human activities, and transportation networks (air, land, sea).

Approach

The approach is to develop and apply time-space network description and analysis techniques that allow for the capture and analysis of the social, economic, natural infrastructure, ecologic, and military assets and restrictions. The description forms a cultural fabric, within which the military is able to efficiently weave an integrated use that accommodates and is supported by the non-military networks.

The region's landscape will be captured within a 4-D GIS environment that allows each voxel (3-D pixel) to be characterized for its ability to support different civilian and military activities. These voxels and their abilities will be connected through networks to identify their relationships over time with respect to their positive and negative influences on surrounding areas (time and space). Proposed training exercise or testing events and their system requirements will the be examined with respect to where they

could be scheduled in a manner that optimizes military needs, local economic needs, and local population acceptance, while minimizing environmental impacts and staying within regional capacities of natural and human-build infrastructures.

The prototype system will allow military planners to propose regional training/testing scenarios that identify the use of resources and assets over time and space. The 4-D GIS environment will be used to evaluate and rank-order proposed solutions. The system will also allow a user (or a community of users) to identify multiple objectives and trade-off preferences among those preferences, which the system will use to propose modifications to user solutions that better meet user-identified objectives.

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4.11 Evaluate Current Installations for Regional Training Potential

Relevance

The value of current installations in the near future will be partly based on their potential to conduct training and testing in their surrounding regions. Analyses of installations today primarily consider the effect of regional influences on the ability of installations to accommodate current missions within their current fencelines. “Encroachment” is defined as the associated negative impact. However, we are recognizing that air, land, and water spaces in proximity to installations are potentially useful for expanding the training and testing capacity of installations. The value of an installation therefore expands from the utility of the natural infrastructure within the fenceline to the utility of shared natural infrastructure outside the installation.

The air used by installations is shared with communities surrounding the installation, hence any air quality concerns must be addressed by all involved. Similarly every location is upstream, in the flow of water, from other locations so that pollutants added to the stream become a larger community and region challenge. Military noise, dust, and smoke are similarly not confined to the installation. Accommodating them requires a community effort. Therefore, the value of on-installation land is based partly on the natural and human infrastructure outside the installation.

JFCOM is currently coordinating joint force training by using multiple installations simultaneously. Therefore, the value of an installation becomes associated with its regional co-location with other installations, firing ranges, bombing ranges, and test areas. Connection to installations is based partly on the distances between installation and partly on the communication and transportation networks between them.

Similarly, the value of an installation in the future is associated with its proximity and access to other surrounding natural and human infrastructure assets that allow for training and testing in a much more distributed approach than is currently being used.

The Sustainable Installations Regional Resource Assessment (SIRRA) program currently provides the best available approach to evaluating the sustainability/utility of installations from the perspective of their surrounding regions.

Objective

The primary objective is to develop and apply an approach for identifying the value of installations with respect to their ability to support training and testing that requires use of regional assets. The end result will be a dispassionate evaluation of each installation with respect to their surrounding regions ability to support expanded training and testing, including joint efforts.

Approach

The SIRRA system and data base will provide the starting point for this work. SIRRA is a compilation of over 60 indicator maps that cover the United States and produced by various Federal agencies outside of the military. Using GIS techniques, any area within the United States (e.g., installation) can be characterized by the information found in the 60+ indicator maps. Techniques must be developed to further characterize installations with respect to their ability to contribute to the support of regional training exercises. As such, the proposed research will attempt to answer/address the following questions:

1. How well is an installation connected through land transportation routes to other installations and potential training areas in the region?
   (Connection is based on land transportation routes currently and potentially available and the opportunity to use those routes without conflicting with civilian purposes.)
2. What is the current value of all lands across the United States to Army training/testing?
   (While land supporting current installations will rank high, potential lands for future installations [or at least training areas] will be identified.)
3. What sets of installations and other training land provide a “natural” opportunity for creation of a multi-installations regional training complex?
   (This analysis will build on the results of answers to the first two questions and identify sets of land across regions [interspersed with urban and agricultural land uses] that might best support Future Force training exercises.)

4.12 Regional Military Training and Testing Support Trends

Relevance

The goal of this work is to illuminate changes in military training and testing opportunities at the county level across regions in the United States since 1960. In a world that is ever changing, it is the job of the Department of Defense to keep pace with new threats to our national security, and identify the future needs of the United States military to meet these threats. During current and future rounds of base realignment and closure, a global repositioning of Soldiers, facilities and weapon systems will occur to meet these changing needs. This will translate to a more efficient, nimble and lethal fighting force that will need to train with future weapon systems and engagement doctrine. In addition, there will be a major influx of personnel returning from abroad and from installations that have been realigned and/or closed. Current installations will have to absorb this influx of units, support infrastructure and dependent families, placing increased pressure on the facilities and training lands needed to accommodate them.

Urban encroachment is an increasing problem for many installations in their current configurations. Shifts in military training tactics and technology will require even more room to maneuver, yet communities surrounding military testing and training areas are projected to grow even more, jeopardizing the Army's ability to provide realistic, relevant training to the war fighter in the future. With this in mind, planners need to look forward to additional training land acquisition that would enable the Army greater training opportunities.

Objective

The objective is to develop, test, and validate new approaches for identifying trends in the value of land across the United States for military training and testing, which will help the DoD identify optimal long-term investments in training/testing land. Using the approaches, maps will be developed that graphically show the changing face of the U.S. landscape with respect to the attractiveness of counties to the support of military training and testing.

Approach

The approach is to compile measurable characteristics of counties across a sample region of the United States that may contribute to the attractive-

ness of the county to military training and testing needs. This information is compiled for two time periods: 1960 and 2000 to allow for the identification of trends over time. This independent data will then be correlated with sample dependent data using a logistic regression model. The dependent data is what we are attempting to predict: military suitability. For correlation purposes, the sample dependent data providing an index to the attractiveness of select counties is developed. Finally, the developed equations mapping the independent data to the dependent variable are applied to the dependent data for all counties yielding an military use attractiveness value that can be displayed in the form of maps.

A sample analysis has been completed. For logistic regression training purposes, sample "Suitable" and "Unsuitable" counties are chosen based on certain criteria. Suitable counties are those that currently contain military installations that will grow based on the recent BRAC 2005 decisions. These counties are assigned a value of 1. Unsuitable counties are those with major cities or metropolitan areas, especially those that lost military capacity in the 2005 BRAC, and are assigned a value of 0. Logistic regression is then performed on those samples to determine relationships among the variables. The resulting equation is then applied to each county in the entire region to determine the suitability for supporting military activities. Because this analysis has been done on the county level, it did not consider land ownership, city location within the county, or individual land tracts.

Independent variable factors were selected based on their potential importance in attracting military training and testing, and their available. Relevant factors included percent of county that is urban, population density, percent of county that is covered by water, percent of land that is under 20 percent slope, and road density (miles of road per square mile of county area). The data was collected for both 1960 and 2000. The same assumptions were made for percent water and percent of county area with a slope of less than 20 percent. Population density and percent urban were not assumed to be constant. Population density was calculated using the 1960 Census data. Road-miles-per-square-mile and the percent-urban maps were not included for 1960 because these data were not readily available.

Approximately 10 counties were identified as currently "attractive" and seven as unattractive and associated with their year 2000 independent variables described above. A logistic regression analysis was performed using the GeoDa (http://sal.uiuc.edu) geospatial analysis software to generate an equation based on the independent variables.

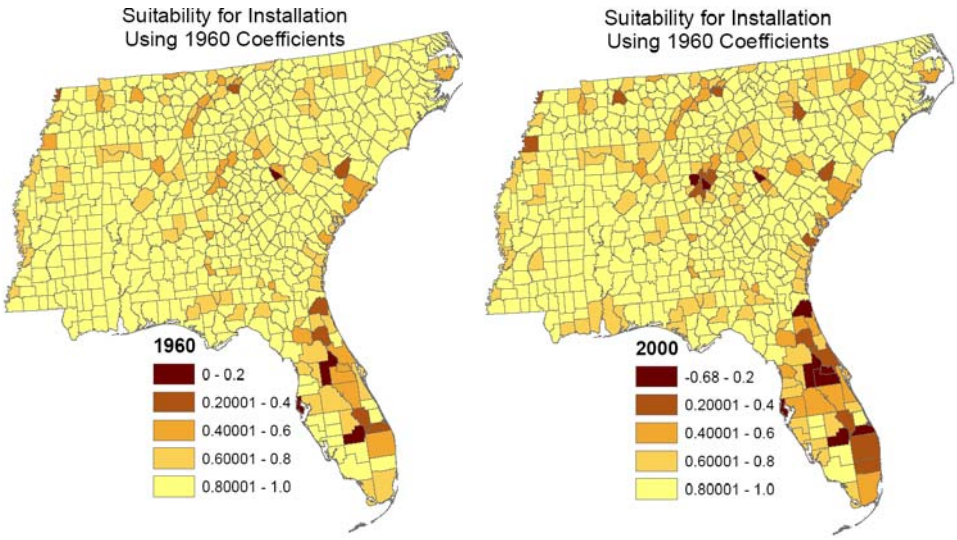

Figure 16. Changes in suitability of counties for supporting military training/testing.

Figure 16 shows some sample results. Darker shades indicate lower suitability counties and lighter shades, higher suitability. The results suggest that there are many counties in the Southeast region of the United States suitable for attracting new training/testing land. Based on the factors used in this analysis, the counties most attractive have few or no cities, are generally flat and do not contain a great deal of water. The attractiveness from 1960 to 2000 drops in many counties.

In 1960, there were only four counties with attractiveness values less than 0.2; there are 10 counties in 2000. Similarly, in 1960 499 counties had an attractiveness value over 0.8, while in 2000 this dropped to 457.

The above analysis demonstrates a useful preliminary approach. With the addition of more independent variables, better correlations are expected. Potential variables include:

- road density
- forested land
- land
- landownership
- threatened or sensitive species habitat.

Additional expertise will be useful in the identification of good example counties used to conduct the regression analysis. In the current analysis, counties with pre-existing military installations were assumed to be good locations. This may be an inadequate assumption if urban encroachment

along the boundaries of some or all of the installations chosen actually lessens the attractiveness of new installation land development.

This analysis suggests that the military is losing opportunities to expand training and testing in the Southeast due primarily to urban settlement patterns. Further analysis is required to include other important factors such as changing military training needs and important new constraints such as the protection of habitat and selected species.

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4.13 Transport of Invasive Plants Over Regional Distances

Relevance

Training on land invariantly involves the inadvertent movement of dirt among areas, which can become a serious problem when that dirt/mud contains seeds of unwanted exotic invasive species. This problem is being handled for vehicle training on installations by washing the vehicle after a training/testing exercise. In a regional training exercise it may not always be appropriate to halt a mock battle situation to wash a vehicle before moving it significant distances. This opens the possibility of unintentionally moving unwanted pest species across a region. Knowing where such species are, where they could spread, and the probability of spreading them at different locations, times of day, and times of season could be important in the analysis (e.g., NEPA) of alternative regional exercise plans.

USDA has responsibility for inspection of cargo and materiel entering U.S. ports, but they are only able to sample a small fraction of the total. They do not inspect any interstate cargo and the responsibility for controlling DoD spread of invasives lies squarely with DoD. Wash procedures are described in the Armed Forces Management Board Technical Guide 31 (http://www.afpmb.org/pubs/tims/tim31.htm). In addition, a February 1999 presidential Executive Order (EO) requires Federal agencies "to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause." In response, the National Invasive Species Council developed guidance (http://www.invasives.gov/) to help identify, detect, and prevent spread. Prevention of the spread of these species protects native habitats, maintains natural training areas, and avoids costs of removing invasives.

Objective

The primary objective is to develop new approaches to effectively and economically identify and control the spread of non-native invasive species that may be inadvertently transported by DoD personnel and vehicles during large training exercises.

Approach

Research will focus on the methods by which invasive species propagules can be transported on military vehicles – especially ground and air vehicles. The times of the year that provide the greatest opportunity to spread invasives will be identified. Techniques that involve proposed cleaning and sterilization procedures will be developed and tested.

4.14 Determining Areas that Are Attractive to Military Development

Relevance

Army and Joint training at the Brigade level and above can require exercises that span great distances – often far beyond the capacity of most installations. It is therefore important to look beyond current installations to identify areas where occasional training exercises might be accommodated. The value of an area is based on what it can physically provide in the form of natural and human infrastructure, the level of local community support that is possible, and the juxtaposition of the area with other areas that together can provide the needed space and capacities to support a needed regional training exercise. Desert Scimitar is an example of a training exercise that uses military and civilian land areas (including towns) to support a many-day exercise. The Army has similar opportunities across the country.

Objective

The objective is to generate a time-series of maps of regions and perhaps the country that identify the trends in attractiveness of land and associated air and water infrastructure to support Army training exercises. This information can be used by military trainers/testers to identify where to best invest in near-term large-scale training opportunities.

Approach

The suitability of an area to support a military training exercise is directly related to the innate suitability of the natural and human infrastructure for supporting the exercise and the level of social, political, legal, and environmental constraints on the use of the area. Much of the available data useful for this research is collected by many Federal agencies at the county and watershed scale and much of this information has been accumulated into the on-line SIRRA system. This database will be statistically analyzed to identify the characteristics of areas that are and are not attractive to military training. Social, environmental, economic, military, and ecological characteristics will be considered through linear and non-linear analyses.

The scientific challenge is how to appropriately rate counties with respect to each index or measure and then to combine these individual ratings into an overall ranking of counties. Multi-Attribute Utility Theory (MAUT) can be adapted to land use suitability analyses (Jankowski & Richard 1994; Keney and Raiffa 1976). Analytic Hierarchy Theory (AHT) also provides a

foundation for turning human preferences on a collection of measures to establish an overall suitability index (Saaty 1990; Finnie et al. 1993). Both approaches help tackle the challenge of formally defining the overall utility of land based on trade-offs among characteristics of the land. For example, for a given training requirement, the amount of land available must be considered with respect to community support and interest in accommodating the training in their county. The trade-off is generally not linear – resulting in a 3-d graph with the individual qualities on the x and y axes and the overall utility on the z. When considering many indices such as social, economic, transportation, environmental, infrastructure, sensitive species, and transportation access to other resources, the non-linear objective function becomes very challenging to capture and solve.

The end products will be new spatially explicit statistical algorithms for computing the current and long-term attractiveness to military installation development across any area, followed by a series of maps generated with the algorithms to identify suitability of land across the United States for supporting several types of Army training. Types will include artillery, tracked vehicle, and aircraft.

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4.15 Characterization of Particulate Matter Generated from Joint Distributed Regional Training

Relevance

Non-facility particulate matter (PM) emissions from training and testing activities is the top priority Army Environmental Quality/Compliance Technology Research and Development User Requirement. Non-facility PM generation activities include troop, vehicle, and aircraft movement, prescribed burning, smoke and obscurant use; open burning and open detonation (OB/OD). Atmospheric PM with diameters < 2.5 μm ($PM_{2.5}$) and diameters < 10 μm (PM_{10}) are regulated because of their ability to cause health effects and degrade human welfare. New regulations have also been proposed that will limit the amount of anthropogenic PM in the atmosphere that cause health effects and degrade visibility. PM in the atmosphere is also used to track or "fingerprint" the sources of the material. The particles' size distribution and/or composition can be used with models to describe the type of sources that emitted the particles. The emissions of PM by the Department of Defense (DoD) need to be quantified by developing mass emission factors for these activities that can be readily used to create emission inventories and integrated as source term components of dispersion models. Methods/systems to quantify these emission factors need to be developed to allow for real time, in-situ, continuous, simple, and economical measurement and modeling of the plumes generated by the sources. This proposal focuses on joint distributed regional training (JDRT).

Objective

The objectives of this project are to:

1. Measure mass PM to determine PM emission factors from DoD's non-facility PM generation sources
2. Develop and modify instrumentation, methods, and systems for the PM emission factor measurement.

We will identify, characterize, and monitor airborne $PM_{2.5}$ and PM_{10} emissions from JDRT. The variability and uncertainty of these emissions will also be quantified. Installation-specific conditions, including soil type and meteorology will be carefully considered when developing the protocol for each source. Databases will be developed during this project and made available to installation personnel for site-specific applications. Results from this project will also be readily available to develop emission invento-

ries for facilities, and to develop more effective environmental compliance and PM control strategies.

Approach

Innovative instrumentation that can be used successfully in the field to characterize ambient PM will be integrated and operated concomitantly to quantify mass emission factors with real time, in-situ, and continuous measurements. The methods also need to be simple and economical for use with future applications. Open path (OP) Fourier Transform Infrared (FTIR) and OP Ultraviolet-Visible (UV-VIS) spectrometers, Light Detection and Ranging (LIDAR), and Aerodynamic Particle Sizers (APSs) will be used as a complete set of in-situ and rapid response measurements to characterize the generation and removal of airborne PM caused by the military operations. Electrostatic low-pressure impaction, aerosol filters, and ion chromatography will also be used to calibrate the in-situ measurements for site-specific conditions (optical, physical, and chemical properties of the PM). These results will then be used to determine the mass of PM emitted from selected military operations depending on the type of source/activity, soil type, and meteorology. These mass emissions will then be related to the source's operation and location to provide mass emission factors.

We will use open path (OP) Fourier Transform Infrared (FTIR) and Ultraviolet-Visible (UV-VIS) spectrometers, real-time point dust monitors, LIDAR, impactors, particle filters, and ion chromatography to provide essential information needed to quantify PM mass emission factors for unique military activities (Figure 17). The OP-FTIR and OP-UV-VIS duel spectroscopic systems have the capability of identifying and detecting dust mass size distribution over long paths required to characterize dust plumes (Hashmonay and Yost 1999; Hashmonay and Harris 2001). Deployment of two spectroscopic systems at the ground level and at an elevated level along with a LIDAR system (Welton et al. 2002; Voss et al. 2001) will provide more range and spatial information allowing improved quantitative interpretation of the PM plumes. Calibration of the in-situ methods for site-specific conditions will be completed using Aerodynamic Particle Sizers (APS) and electrostatic low-pressure impaction (ELPI) to determine particle size distributions. Particle filters, ion chromatography, Aerosol Inorganics Model (AIM) software (Clegg et al. 1998), and chemical/physical databases will be used to determine the PM's composition, density, and refractive index. Integrating these methods will enable a carefully calibrated in-situ and real-time quantification of PM mass emissions.

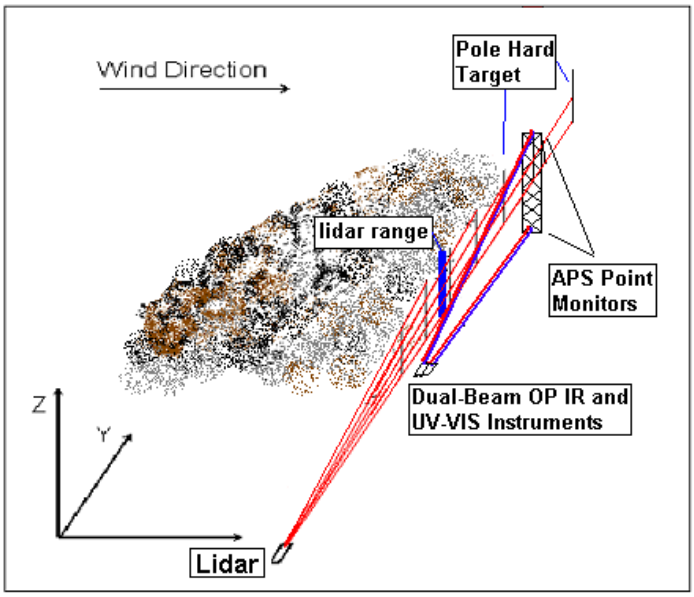

Figure 17. Schematic of experimental set-up to measure dust emission factors from military operations.

Recently improved micro-pulse LIDAR technology is also proposed to enhance data quality. By situating hard targets over the measurement domain, the range of the LIDAR system will be extended across the entire plume, which is an issue for dense plumes that can be generated by military activities. Reflecting the LIDAR beam from hard targets will generate light transmission/extinction data that is useful in two ways. This approach will provide: (1) reliable inversion of the LIDAR equation as described below; and (2) better penetration into the dust plume in the dense near-field conditions and significant extension of the LIDAR measurement distance.

We will concurrently implement OP-FTIR, OP-UV-VIS spectroscopy, real time point dust monitors and LIDAR with detailed wind measurements along downwind vertical planes to calculate the emission flux and cross-sectional area of the plumes generated by the military sources. This measurement configuration will provide important information to convert the LIDAR extinction distribution data into mass concentration distributions, and thus in conjunction with the wind measurements, reliable particulate mass fluxes. Fugitive dust mass emission fluxes will be the underlying information for emission factor determinations per military activity, soil type, and meteorology.

Removal mechanisms and the rate of removal of the PM will also be considered during protocol development, plume measurement, and emission

factor modeling of the plumes. The variability and uncertainty of these emissions will also be quantified. Installation-specific conditions, including soil type and meteorology will be carefully considered when developing the protocol for each source.

Databases developed during this project will be made available to installation personnel for site-specific applications (e.g., source operation, soil type, meteorology). Results from this project will also be readily available to develop emission inventories for facilities, develop more effective environmental compliance and PM control strategies, allow for better planning of unimpeded training and operational activities, and limit local and regional visibility degradation that may provide operational signatures.

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The following papers were presented by principal investigators in the recent National Air related Conferences from SERDP project results. The proposed methods need to be refined for JDRT environment:

Du, K., M. Rood, B. Kim, M. Kemme, R. Hashmonay, and R. Varma. (2006). "Optical Remote Sensing of Dust Plumes Using Micropulse Lidar." *99th Annual Meeting of the Air & Waste Management Association*. Paper No. 315. June 20-23, New Orleans, LA, p 10.

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4.16 Mobile Training Facilities

Relevance

A large training exercise that makes good use of regional natural infrastructure capabilities may improve the overall value of the training by providing Soldiers with experiences on non-military land. Facilities, targets, and other resources, are often provided as fixed structures on installations. Consider the case of a regional training exercise that makes use of several installations; interstate, Federal, and state highways; private timberland; and state and county parks. To optimize training realism and effectiveness, it would be best to engage targets while traveling through the private forest and to interact with a small village in a state park. One option for accommodating both of these requirements is to deploy targets and towns in a manner that allows them to be set up immediately before and taken down immediately after use. The result is that the Army would be able to accommodate realistic training in many different places and in a manner that allows the training to be part of a greater training exercise.

Objective

The objectives of this project area are to:

1. Develop new technologies and assess materials that allow for rapid forward-deployment of temporary training support facilities, buildings, and targets
2. Establish strategies to develop mobile training facilities that minimize the military's environmental disturbance "footprint" on public or private lands used temporarily for training
3. Develop pre-training, in-training, and post-training vegetation and land-use management mechanisms
4. Develop assessment tools to rapidly quantify temporary land-use disturbance risks.

The development of such capabilities would allow a training exercise to be set-up within a day, provide a designated timeframe of training support, and be removed within a day. Mobile training facilities development seeks to improve training realism and troop readiness while simultaneously protecting public health and safety and ensuring the land is available for future use by other stakeholders (other Federal/state agencies and civilians).

Approach

This effort will begin with a workshop at which participants from ERDC, academia, and the military will participate in a "blue-sky" session at which engineering limitations are temporarily set-aside. The types of ideas that will be brainstormed include, but are not limited too:

- modular targets and buildings
- materials and technologies for barriers, portable walls, scenes, buildings, targets, etc.
- back-packable targets
- crates and storage boxes that can be deployed by helicopter and rapidly transform into targets and buildings
- devices that provide electronic signatures on sensors to simulate an opposing force
- natural landscape for siting and placement of structures (terrain matching)
- alternative natural materials suitable for temporary training (mulch berms, temporary UAV landing strips, bivouac areas, etc.)
- novel vegetation and re-vegetation techniques that take advantage of disturbance activities (seed dispersal and seed germination mechanisms)
- new and innovative engineering technologies will also be considered that can support remote temporary training such as biodegradable paints and materials that can generate the appearance of physical structures on and across natural landscapes.

Once the initial brainstorm session is completed, realistic products fitting within the scope of the objectives will be identified. Product development will then be categorized as short term or long-term and a review process established to determine science and technology gaps for each recommended product development area. As the science and technology needs for each area are recognized, the basic answer to the question, "How does the military build a mobile range facility?" will start to take shape.

The process of mobile military facilities development involves effective land use management planning, proper siting and innovative structures design and construction. First and foremost is the military's responsibility to effectively train our forces in realistic scenarios. Given today's battlespace training requirements, mobile military facilities as part of the installation network (either geographically connected or disconnected) have the potential to be highly effective training areas. However, given the increas-

ing focus on the sustainable use of military training areas both temporary and permanent, it is necessary to create a temporary facility that is a valuable training asset and causes a minimal environmental disturbance in the setting of use.

To identify temporary land use limitations requires a process to identify temporary training risks and the ability to efficiently assess and model potential land use impacts. An effective land use management plan will help determine the ecological sensitivity of the area and the associated risks even if they are temporary. Additionally, the land use management strategies should be able to ascertain how much disturbance a designated temporary training site can withstand and when and where land rehabilitation should occur. Proper assessment of ecological disturbance potential is particularly critical during the siting phase of a mobile training facility. A well-placed temporary training area will provide training in the best possible situational context and will minimize environmental disturbance. Given the portable nature of a mobile training facility, proper siting will be a key factor and new tools are necessary to rapidly assess siting needs.

Recent developments in biodegradable materials and biocomposites technologies have the potential to significantly affect the building materials selection process and alter the environmental footprint of a temporary facility. In addition to the environmental benefits, newer lightweight components lend themselves to portability and transport to various sites and may be ideal for modular construction. This is an area of materials science undergoing rapid development; new products are entering development at an extremely fast pace. The use of these new materials in a military training setting has not been sufficiently explored and significant gaps in our understanding of these materials are extensive.

In addition to synthetic construction materials for temporary range facilities, there is the potential to use natural materials as targets, structures, edifices etc. The advantage of the use of natural materials is that the majority of these structures will decompose naturally in the field, a distinct advantage for temporary structures. The use of compost/mulches in the field promotes plant growth and seed germination. Studies involving the use of this material have illustrated its ability for use in erosion control, sediment reduction and vegetation establishment (Risse et al. 2005). The limitations and usefulness of natural structures in combination with naturally derived bio-products is seemingly endless.

This proposal has briefly outlined an overview of the potential for mobile/temporary training facilities and associated products. Additionally, it also highlighted the need for further development of planning, siting and design/materials of specific areas with regards to the proposal objectives. A more in depth investigation as to the feasibility of mobile training ranges is required to examine the potential impact of these facilities.

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4.17 Optimizing the Acquisition of ACUB Property Over Time

Relevance

The sustainability of Army installations relies on the acquisition of property rights that allow installations to maintain their training and testing opportunities within their fence lines. The Army Compatible Use Buffer (ACUB) program provides a mechanism to protect neighboring properties in a manner that helps maintain the opportunities. One use of ACUB is to purchase property development rights that can result in the maintenance of habitat for threatened and endangered species (TES) and species at risk (SAR) that can help improve the viability of populations for which the installation is responsible. To be successful, a reserve must be designed and developed that results in the target population viability, rights must be purchased from willing sellers, and purchases must take place within a defined budget over the course of several years.

Objective

Consider, for example, a typical ACUB challenge illustrated by Figure 18. Fort Benning has identified nearby land that has been identified as attractive for ACUB property development rights purchased. A budget is expected to allow acquisition of these rights over several consecutive years.

The challenge is to acquire land in a manner that, in the end, optimizes training and testing opportunities within Fort Benning. This will be accomplished indirectly by protecting habitats off-installation that will decrease the pressure to protect habitat for the maintenance of TES and SAR on the installation.

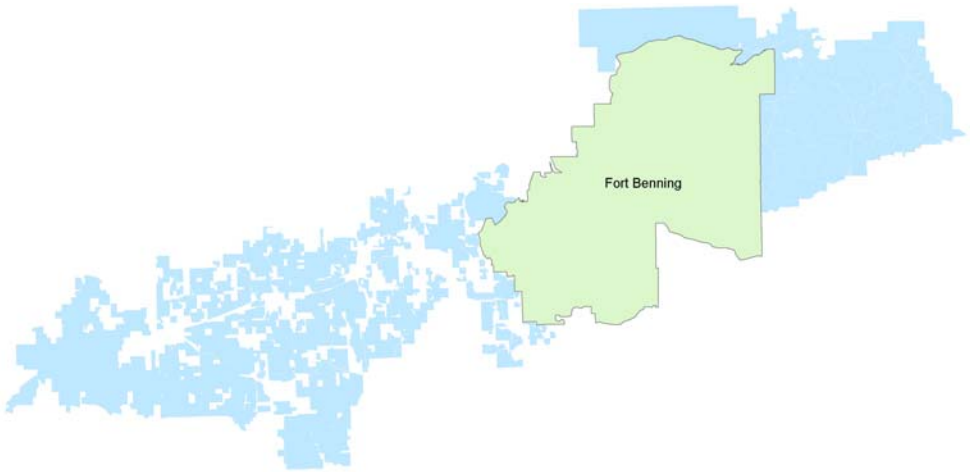

Figure 18. ACUB nominated land

As land owners choose to make their property development rights available over time for ACUB acquisition, it is necessary for DoD and the installation to purchase wisely over time and over space. Over space each land parcel has some intrinsic value as habitat and as installation noise and dust/smoke buffer areas. Over time, the purchase price of those rights will change as will the willingness of the sellers. The objective is to develop a process by which purchase decisions can be made as funding becomes available that will, ultimately, result in the creation of a TES or SAR reserve that optimizes the training/testing opportunities on the installation.

Approach

Mathematically based designs for conservation reserve networks have been developed and explored. Approaches have typically been heuristic or have employed formal linear integer programming optimization. A heuristic algorithm called the "greedy heuristic" procedure (Pressey, et al. 1993) identifies the area that contributes the most, by itself, to an objective by ranking all areas. The remaining areas are re-ranked according to their additional contribution to select a second area. The procedure continues until the overall objective (e.g., all species are represented) is satisfied. This procedure generally identifies a sub-optimal solution. Önal and Briers (2005) developed a linear integer programming approach that optimized the compactness of a reserve based on qualities of eligible parcels and the need to meet certain objectives and constraints. Additionally, Önal (2003) demonstrated that near-optimum solutions that are always better than heuristic solutions, could always be achieved using commercial integer programming software packages.

Unfortunately, all of these approaches presume the ability to follow-through and acquire the land and property rights to establish the optimal reserve. In multi-ownership realities, the production of reserves is typically accomplished step-by-step over the course of many years, during which time, many of the variables change. Game-theory (Kelly 2003) offers opportunities to optimize the probability of interacting over time with a number of stakeholders and property owners to ultimately create a reserve that accomplishes the needs of the installation.

Piecemeal purchase of property to achieve ACUB goals is similar to a game of chess. Each purchase is a move that must be made based on the current known state of the land or chessboard, and the probabilities of actions of others. In the ACUB reserve creation process, we know and can formally capture such things as the current land use and land cover, the size and

ownership of parcels, the probably cost (per acre) of each parcel, the value of the parcel to a species and to the military (in direct support of training/testing), the probability of property owners being willing to sell, and the available funding for purchasing property rights. The purchase of a set of rights for a set of properties will change some of the known information and will accompany changes based on other social dynamics including road construction, neighborhood developments, population growth, and economic changes. These are the "moves" made in the landscape evolution game by other participants. The fundamental notions of game theory will be applied to the design and development of a landscape change simulation model that will assist installation ACUB managers optimize their decisions by projecting the consequences of alternative decision sequences. We expect, for example, that "aggressive" decisions will have the potential for dramatic returns on investments, but that "conservative" approach will be associated with higher probabilities of success.

The approach will be a synthesis of GIS, urban growth, habitat fragmentation, and population viability modeling. Primary outputs of the application of the approach will be indicators of relative potential payback and risk associated with each parcel/location. This information, combined with maps showing locations of willing buyers, can then be used to select property rights purchases with available funding in a particular year.

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5 Conclusion

This study has investigated requirements for a joint, distributed, and regional land use strategy that will facilitate the Army and DoD's ability to develop training/testing areas and large multi-service exercises within increasingly populated areas and regions, i.e., an emerging solution that entails the use of regional training assets composed of multiple installations and non-DoD lands.

This work has also specified the scope of research and development (R&D) efforts, analyses, and studies required to facilitate a shift to a strategy of sharing future space among private, commercial, county, state, and Federal stake-holders, and proposed studies in the following areas:

- Effects of Military Training on Archaeological Sites (p 40)
- Characterize Training and Testing Needs of Future Systems (p 47)
- Maintain Readiness by Improving Regional Training Capacities: Development of Regions of Military Influence (p 49)
- Social Impact of Occasional Regional Training Exercises on Communities (p 54)
- Training in Real Urban Environments (p 56)
- Developing a Process for Community and Installation Communication (p 61)
- Context Specific Military-Unique Delivery of Real-Time Geospatial Information Products (p 65)
- Optimal Training of Army Forces Using Regional Assets (p 70)
- Evaluate Current Installations for Regional Training Potential (p 72)
- Regional Military Training and Testing Support Trends (p 74)
- Transport of Invasive Plants Over Regional Distances (p 78)
- Determining Areas that Are Attractive to Military Development (p 79)
- Characterization of Particulate Matter Generated from Joint Distributed Regional Training (p 81)
- Mobile Training Facilities (p 86)
- Optimizing the Acquisition of ACUB Property Over Time (p 90).

The study team determined that there were not sufficiently documented Army requirements at the time of the study to recommend creation of a dedicated Joint Distributed Regional Training work package using Army applied research (6.2) funds. In addition, some of the proposed topics were determined to be more appropriate for customer-funded reimburs-

able studies. Some of the issues likely to arise from increased Joint and distributed training may be “ahead of their time.” The study team recommends that ERDC use this report as a basis to work with the Army Environmental Requirements and Technology Assessments (AERTA) process to develop validated requirements upon which future and more focused work packages can be based.

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Appendix A: Army Requirements Survey

The following survey was presented and administered at an informal panel at a meeting hosted by IMA-SERO, Fort McPherson, Atlanta, GA on 17 March 2006, to determine current Army requirements.

The Army must eventually look outside current installations for training areas because of requirements associated with:	Strongly Disagree (0)	Disagree (1)	Agree (2)	Strongly Agree (3)	
New weapon systems, new training doctrine, joint service training force transformation	0	0	5	4	2.44
Evidence that the Army must look outside current installations:					
"Encroachment" is a primary Army & DoD concern	0	0	3	6	2.67
Loss of military training land and/or times	0	0	5	4	2.44
Persistent move towards more Joint Training	0	1	6	2	2.11
Future Force needs far more training area than currently available	0	1	2	4	2.43
More off-installation training exercises required	0	0	4	5	2.56
Development of training simulators	0	0	8	0	2.00
The Army is losing off-installation training/testing opportunities	0	1	4	3	2.25

Rank-order the following Army concerns:	1	2	3	4	5	6	7	
Reverse current urban encroachment on military installations	1	2	3	1	0	1	0	3.00
Protect installations from further urban encroachment	4	3	0	0	1	0	0	1.88
Conduct Joint-Land-Use-Studies	2	1	1	1	1	0	2	3.75
Expand installations	1	0	1	1	1	0	3	4.86
Identify opportunities to conduct large training exercises	0	1	2	2	0	3	0	4.25
Insufficient installation space to support the "future force"	1	1	1	1	1	1	1	4.00
Accommodate Joint Training Exercises	0	0	1	1	3	1	1	5.00

Potential R&D	Importance					
	Not	Low	Med	High	Very	Avg
	0	1	2	3	4	
Identification of past, current, future suitable Army training areas in the United States	1	0	1	2	4	3.00
Optimization of future land use patterns to optimize DoD and competing interests	1	1	2	1	4	2.67
Regional training/exercise designer	1	0	4	2	1	2.25
Optimizing training throughput	1	0	3	4	1	2.44
Impact of occasional regional training exercises on TES	1	1	2	4	0	2.13
Natural and civilian reaction to infrequent military training noise	1	3	3	0	1	1.63
Impact of occasional regional training exercises on archeological sites	1	1	4	1	1	2.00
Alleviating the risks of spreading exotic plant species during regional exercises	1	4	3	0	0	1.25
Optimal strategies for coordinating regional exercise planning with communities	0	3	1	2	3	2.56
Predicting future pressures on regional airspace	0	0	2	4	2	3.00
Designing “Mobile Training Facilities”	1	2	1	2	1	2.00

Potential R&D ()	R&D Needed					
	Not	Low	Med	High	Very	
	0	1	2	3	4	
Identification of past, current, future suitable Army training areas in the United States	1	0	4	2	1	2.25
Optimization of future land use patterns to optimize DoD and competing interests	1	1	3	2	2	2.33
Regional training/exercise designer	1	3	2	0	2	1.88
Optimizing training throughput	1	4	1	0	2	1.75
Impact of occasional regional training exercises on TES	2	2	3	1	0	1.38
Natural and civilian reaction to infrequent military training noise	1	5	2	0	0	1.13
Impact of occasional regional training exercises on archeological sites	2	4	2	0	0	1.00
Alleviating the risks of spreading exotic plant species during regional exercises	2	4	0	1	1	1.38
Optimal strategies for coordinating regional exercise planning with communities	2	4	0	1	1	1.38
Predicting future pressures on regional airspace	0	0	3	3	1	2.71
Designing “Mobile Training Facilities”	1	2	1	2	1	2.00

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14. ABSTRACT

Current Army National land use strategy seeks to protect current training/testing areas, and address shortcomings with computer simulation, a strategy insufficient to completely meet future training and testing needs. The transformation of the U.S. Army and Department of Defense (DoD) will incorporate new weapons and tactics requiring more training land and more frequent joint-Service training than current fenced installations containing tracts of contiguous land can accommodate.

This document investigates the need for a joint, distributed, and regional land use strategy that will facilitate the Army and DoD's ability to develop training/testing areas and large multi-service exercises within increasingly populated areas and regions. It examines capabilities that will be required to adopt this strategy and specifies the scope of research and development efforts, analyses, and studies required to fill capability gaps. The study team determined that Army requirements were not sufficiently documented at the time of the study to recommend creation of a dedicated Joint Distributed Regional Training work package using Army applied research (6.2) funds. This team recommends that ERDC use these results as a basis to work with the Army Environmental Requirements and Technology Assessments (AERTA) process to develop validated requirements upon which to base more focused work packages.

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